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U.S. Army Aeromedical Research
Laboratory Annual Progress Report
FY 1986

Reported by
Dudley R. Price, Colonel, MC, SFS

October 1986

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USAARL

AD-A228 436

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE				Form Approved OMB No. 0704-0186	
1a. REPORT SECURITY CLASSIFICATION Unclassified			1b. RESTRICTIVE MARKINGS		
2a. SECURITY CLASSIFICATION AUTHORITY			3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution unlimited.		
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE					
4. PERFORMING ORGANIZATION REPORT NUMBER(S)			5. MONITORING ORGANIZATION REPORT NUMBER(S)		
6a. NAME OF PERFORMING ORGANIZATION U.S. Army Aeromedical Research Laboratory		6b. OFFICE SYMBOL (if applicable)	7a. NAME OF MONITORING ORGANIZATION U.S. Army Medical Research and Development Command		
6c. ADDRESS (City, State, and ZIP Code) P.O. Box 577 Fort Rucker, AL 36362-5292			7b. ADDRESS (City, State, and ZIP Code) Fort Detrick, Frederick, MD 21701		
8a. NAME OF FUNDING/SPONSORING ORGANIZATION		8b. OFFICE SYMBOL (if applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER		
8c. ADDRESS (City, State, and ZIP Code)			10. SOURCE OF FUNDING NUMBERS		
			PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.
					WORK UNIT ACCESSION NO.
11. TITLE (Include Security Classification) U.S. Army Aeromedical Research Laboratory Annual Progress Report FY 1986 (U)					
12. PERSONAL AUTHOR(S) Dudley R. Price					
13a. TYPE OF REPORT Annual		13b. TIME COVERED FROM Oct 85 TO Sept 86		14. DATE OF REPORT (Year, Month, Day) October 1986	
15. PAGE COUNT 107					
16. SUPPLEMENTARY NOTATION					
17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)		
FIELD	GROUP	SUB-GROUP	Annual Progress Report, FY 86		
19. ABSTRACT (Continue on reverse if necessary and identify by block number) The Annual Progress Report gives the FY 86 personnel and funding strength of the U.S. Army Aeromedical Research Laboratory. It outlines the 11 scientific programs being pursued by the Laboratory. These programs are: Visual and auditory physiology; auditory effects of blast overpressure; noise hazards of combat vehicles; impact biodynamics of crashworthy aviation equipment and personnel armor; vibration hazards of combat vehicles; crew life support systems technology; sensory limitations and man/machine systems; biomedical aspects of crew workload, selection, and staffing; anthropometry and ergonomics: criteria for Army aviators; and antidote and antidote/agent effects on the visual system.					
20. DISTRIBUTION/AVAILABILITY OF ABSTRACT <input checked="" type="checkbox"/> UNCLASSIFIED/UNLIMITED <input type="checkbox"/> SAME AS RPT. <input type="checkbox"/> DTIC USERS			21. ABSTRACT SECURITY CLASSIFICATION Unclassified		
22a. NAME OF RESPONSIBLE INDIVIDUAL Dudley R. Price			22b. TELEPHONE (Include Area Code) (205) 255-6917		22c. OFFICE SYMBOL SGRD-UAC

DD Form 1473, JUN 86

Previous editions are obsolete.

SECURITY CLASSIFICATION OF THIS PAGE
Unclassified

Mission

Conducts research and development on health hazards of Army aviation, tactical combat vehicles, and selected weapons systems. Assesses the health hazards from noise, vibration, acceleration impact, and visual demands of such systems, and defines measures to offset hazards. Assesses stress and fatigue in personnel operating these systems and develops countermeasures. Assists in development of criteria upon which to base standards for entry and retention in Army aviation specialities. Assists other U.S. Army Medical Research and Development Command (USAMRDC) laboratories and institutes in research on the bioeffects of laser systems, medical defense against chemical agents, impact of continuous operations on individual and crew performance, and development of improved means of patient evacuation. Assesses current life support equipment to identify causes of failure and devises improved design. Assists the combat developers and materiel developers of new Army aviation and tactical combat vehicle systems to recognize and eliminate health hazards as early as possible in the developmental cycle. Conducts collaborative research with other Department of Defense and federal agencies on medical research and development issues of common concern.



COL Dudley R. Price
Commander

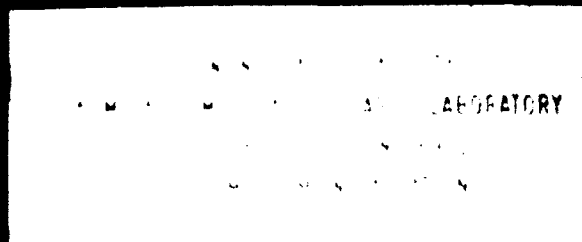


COL J.D. LaMothe
Deputy Commander
for Science



LTC Edmond J. Enloe
Deputy Commander
for Administration

COMMANDER'S AWARD ★ ★ ★ ★ FOR EXCELLENCE



UNITED STATES ARMY
TRAINING & DOCTRINE COMMAND

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Introduction

Research goals are derived from a thorough review of threat information and ongoing doctrine development as portrayed in AirLand Battle 2000 concepts; further impetus is driven by the understanding of the recognized Army deficiencies contained in the Mission Area Analysis (MAA). The total research mission is in consonance with the priorities established by Headquarters, U.S. Army Medical Research and Development Command (USAMRDC), Fort Detrick, Frederick, Maryland.

The United States Army Aeromedical Research Unit (USAARU) was established by The Surgeon General with the mission to conduct research in support of the Army aviation community and airborne activities, and to provide a central aeromedical research and reference library for the Army aviation effort. The unit was redesignated as a laboratory (USAARL) in late 1969. Additional mission areas were added to the Laboratory in the 1970s. The Laboratory's further expanded mission now includes the assessment of the medical impact of advanced armored and artillery weapons systems and other nonmedical materiel. Major emphasis is placed upon the prevention of health hazards of emerging weapons systems and the enhancement of soldier performance. New research programs in medical chemical defense recently have been added.

USAARL is one of 11 medical research laboratories and development activities of the U.S. Army Medical Research and Development Command, Office of The Surgeon General, and is a tenant activity located at the U.S. Army Aviation Center (USAAVNC), Fort Rucker, Alabama. While it is the only medical laboratory designed to deal with Army aviation's unique occupational problems, its specialized research disciplines are applied throughout most military systems and operations.

In its 25 years, the Laboratory's growth has seen it progress from one wooden building with 7 assigned personnel to a large, modern brick facility with 136 personnel authorized. Our growth has been in research, people, and facilities, and we're proud of them all.

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Under the direction and guidance of USAMRDC, USAARL moves with the sure steps of maturity and responsibility of a firmly established research organization. The mission remains, through research, to preserve and enhance the health, safety, combat effectiveness, and survivability of the soldier. We are a blend of basic and applied medical research designed for timely responses to critical operational- and field-oriented problems.

The Laboratory's significant contributions to the Army, and especially Army aviation, were recognized by the Training and Doctrine Command's (TRADOC) selection of USAARL as the recipient of the 1986 Non-TRADOC Unit Award for Excellence. This was the second consecutive year USSARL has been honored with this award.

This report gives an overview of USAARL during FY 86, identifies current areas of research, and gives a brief description of the research programs.

This report is prepared to fulfill the requirements of OTSG Regulation 70-31.

Management

Headquarters

The Headquarters Group, in addition to the Commander, Deputy Commander for Science, Deputy Commander for Administration, Director, Programs and Plans, and Liaison Officer to Aviation Systems Command (AVSCOM), consists of the offices of the Adjutant/Detachment Commander, the Scientific Information Center, and the Resource Management Branch.

Office of Adjutant/Detachment Commander

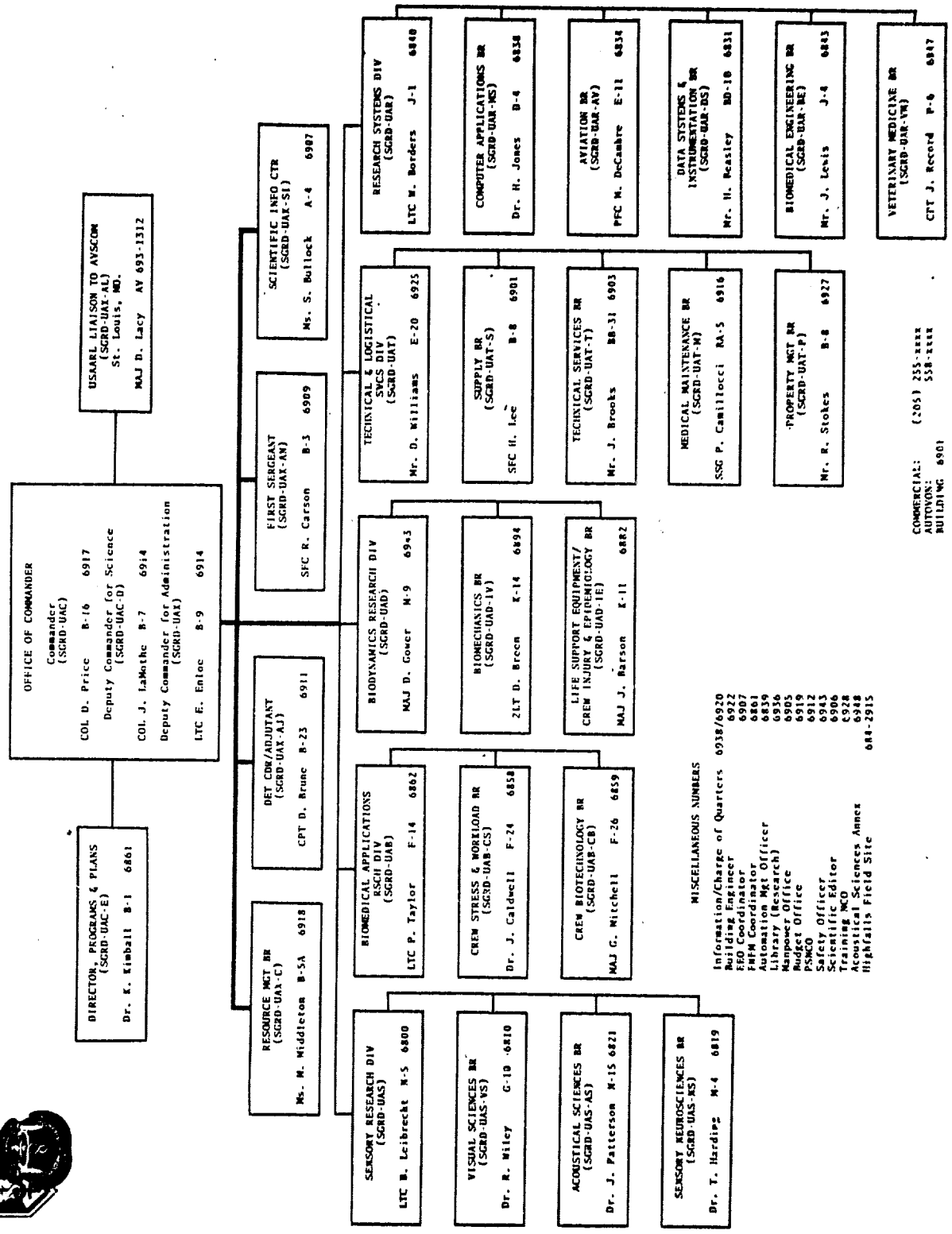
The Office of the Adjutant/Detachment Commander provides command and control over all military personnel to include personnel actions, disciplinary actions, billeting, and training. This office manages the physical security and the information security programs for the Laboratory. It also coordinates and supervises the administrative functions, postal services, and related office service operations of the USAARL headquarters.

The Adjutant/Detachment Commander's office supervised and coordinated the protocol affairs involving visitors. During FY 86, the Laboratory received over 2,800 visitors. Visitors included the Commanding General and Deputy Commanding General, U.S. Army Medical Research and Development Command, Commanding General and Deputy Commanding General, U.S. Army Aviation Center, Commanding General, U.S. Army Aviation Systems Command, and the Chief, U.S. Army Medical Service Corps. Foreign distinguished visitors came from the United Kingdom, Canada, France, the Federal Republic of Germany, and Australia.

USAARL hosted the U.S. Army Medical Research and Development Command's Commanders' Conference in January, the Helmet Mounted Display meeting in February, the Tri-Service Aviator Helmet Standardization Group in September, and the Tri-Service Aeromedical Research Panel in December.



UNITED STATES ARMY AERONAUTICAL RESEARCH LABORATORY
FORT RUCKER, ALABAMA 36362-5292



COMMERCIAL: (205) 255-XXXX
AUTODON: 558-XXXX
BUILDING: 6901

Resource Management Branch

The Resource Management Branch provides services in fiscal and manpower management and civilian personnel administration. Other services, such as training and incentive awards programs, are administered by this branch.

Significant accomplishments in manpower/personnel support during FY 86 included filling all vacant authorized full-time permanent civilian positions to include five science and engineer posts. Also, one scientist has been added to the Laboratory staff for a 2-year period under the Intergovernmental Personnel Act of 1970.

A notable accomplishment in information management was the establishment of an information database for functions and processes with the Resource Management Branch. This information includes a record of training, awards, educational background, promotions, etc. for assigned personnel and staffing document and TDA for authorized manpower positions at USAARL. There were 170 training experiences provided to Laboratory personnel. This training included skills development, professional development, and equal employment opportunity training. An ongoing problem continues in the ability to recruit and place qualified applicants in engineering and scientific positions.

Scientific Information Center

The Scientific Information Center (SIC) project of library automation continues. The contract awarded to Online Computer Library Center (OCLC), Dublin, Ohio, to install the LS2000 Integrated Library System has progressed to the extent the entire book collection of over 15,000 volumes has been barcoded. Nearly 10,000 technical reports also have been barcoded. An additional 3,000 microfiche titles are scheduled to be entered into LS2000 database. SIC's collection of 400 journals has been added to the system. All 310 of USAARL's technical reports also have been barcoded and added to this retrieval system.

All of the holdings --- line drawings, still photographs, motion pictures, and video tapes --- of the Scientific Arts Branch are in the process of being entered into a separate

Branch are in the process of being entered into a separate section of the LS2000 system for easy retrieval.

The SIC provided the training course "Basic Library Skills" for local medical libraries in SEASHEL Consortium. The SIC gave four orientation classes to flight surgeon students.

In addition to the OCLC and NASA RECON databases, SIC also uses the DIALOG databases and Defense Technical Information Center (DTIC) database. SIC has added these online services: Wilson line, an online database for all Wilson indexes; Information-on-Demand, a document delivery service; and EBSCO, a jobber for SIC's journal subscriptions.

Over 2,000 requests for information were received and filled using electronic databases. Most requests for USAARL research reports are filled by DTIC and NTIS; however, the Laboratory received and filled by direct mail or walk in over 150 requests for our publications.

The Laboratory's writer-editor's office edited and had published 15 technical reports and 9 letter reports. An annotated bibliography of all USAARL technical and letter reports from June 1963 to September 1986 was compiled by the Writer-editor's office and published.

Support divisions

Research Systems Division

The Research Systems Division provides Laboratorywide support in the areas of biomedical engineering, data systems and instrumentation, computer applications and services, aviation, and veterinary medicine. During FY 86, many instrumentation systems were designed, built, and installed; computer user accounts were increased and numerous user applications were developed; and many missions were flown in support of research protocols and Laboratory management; the animal colonies remained constant, though species were changed; and a vivarium expansion was completed. Specific branch activities are detailed below.

Veterinary Medicine Branch

The Veterinary Medicine Branch continued to provide quality laboratory animals for research purposes during FY 86. Veterinary support was provided in the several areas of research. In addition, veterinary technicians were called upon to assist in the development of a porcine suspension harness and in the training of 30 porcine subjects.

The Laboratory's chinchilla breeding colony has increased significantly its production this fiscal year. This increase comes as a result of improved environmental conditions implemented by USAARL researchers and consulting veterinarians. We hope to maintain this success and have ordered new breeding cages for the colony. All USAARL veterinary technicians have been certified as Assistant Laboratory Animal Technicians by the American Association of Laboratory Animal Science this year. To finish off the year, we saw the completion of a cage storage facility and the continuation of cabinet installation in the new wing of the vivarium.

Biomedical Engineering Branch

The performance and accuracy of the Aircraft In-flight Monitoring System (AIMS) was evaluated. This LSI-11/2 computer-based system with associated signal conditioning is connected to signals from aircraft sensors and other instrumentation to monitor pilot performance and physiological data. New parameters were added to accommodate requirements of the second phase of the atropine study.

To test the feasibility of using artificial intelligence in evaluating combat medicine emergencies, computer interface circuitry and equipment was designed, fabricated, and tested. These devices will connect patient simulators and IV pumps with the diagnostic computer to demonstrate the operational capabilities of the system.

An instrumentation system was designed and assembled for the USAARL .50-caliber range in support of a project to evaluate body armor for Army pilots. Incorporating new software features, procedures were written for the operation of an IBM PC-based transient data recording system that stored the test data. Approximately 20 tests were conducted measuring forces, loads, and velocities.

The Biomedical Engineering Branch maintained an instrumentation system to monitor the physiological parameters of the second group of five atropine test subjects flying the USAARL simulator. Heart rate and respiration data was monitored, recorded, and plotted under computer control.

Specifications were established for a walk-in environmental chamber, an electrodynamic vibration table, and a digital vibration controller. Also, installation and checkout were completed for an electromagnetic emissions and susceptibility test system, an RF shielded enclosure, and the vibration table/controller. These and other associated devices will be used in testing aeromedical equipment for use in Army helicopters.

Analysis of sensor problems led to the specification of new ones for a portable 21-channel vibration recording system to gather ride quality data on prototype Army vehicles.

The application software was written to gather tank gunner head and chest acceleration data with a field portable PC-based acquisition system.

Data Systems and Instrumentation Branch

The FY 86 work effort was distributed laboratorywide with a major portion of support directed toward preparation for two scheduled research projects, atropine (second phase) and the Army program for testing and evaluation of aeromedical equipment. A special effort was made to modify and reconfigure the Physiological Data Transmitting System and the Video and Audio Transmitting System for use in the airborne phase of the atropine study. Rooms inside the Multi-Axis Vibration System (MAVS) facility were renovated to house the new electromagnetic shaker. The helicopter operational trainer was maintained in an operational condition to support the atropine (phase II) project.

The MAVS was used to provide vibration stimuli for the Counterobstacle Vehicle Seat Test. Cabling was provided for the VAX Data System to include maintenance and expansion to Lyster U.S. Army Community Hospital here at Fort Rucker in support of the Aviation Epidemiological Data Register.

Aviation Branch

The Aviation Branch saw FY 86 as a year of consolidation and in-house support. Significant effort was expended in preparing equipment and flight testing systems and profiles to be used during the upcoming flight initiative in support of testing chemical warfare antidotes and pretreatment therapies. Airborne video systems and telemetry were installed in the UH-1 aircraft and the OH-58 was configured for retransmission of these signals. Flight testing and airworthiness were completed.

Aviation training requirements remained high and the Laboratory had 10 aviators assigned to operational flying positions at the close of the year. Three transitions into the U-21 aircraft were completed and two into the OH-58. Several new aviators were assigned and integrated into the Laboratory's aircrew training program.

Two major aircraft system procurements are on track and much effort was expended in their support. A new UH-60A aircraft will be delivered to the Laboratory during the last quarter of FY 87, and a UH-60 flight simulator will be delivered during the first quarter of FY 88. Both systems will enhance significantly the Laboratory's aviation research efforts.

Computer Applications Branch

The Computer Applications Branch's main emphasis in FY 86 has been the support of several of the Laboratory's major research projects. This support has been provided by the branch's scientific and programming staff through the design and implementation of project specific computer software and hardware and by providing USAARL researchers with powerful computing tools for data acquisition, analysis, and evaluation. In addition, the branch made significant contributions to the management of USAARL by providing numerous automated administrative programs, and by performing information resource management duties through the newly-created position of Information Management Officer (IMO).

The primary hardware tool used to support the Laboratory's computing needs in FY 86 continued to be the VAX-11/780 central computer. Service was provided on a 24-hours-per-day, 7-days-a-week basis to the 161 system users through a multiplexor network in the Laboratory, and through concentrator-modem connections with the U.S. Army Aeromedical Activity at Lyster U.S. Army Community Hospital (in support of the Aviation Epidemiology Data Register). Hardware enhancements during this reporting period include an expansion of the VAX computer memory to 16 megabytes, increased from 4 megabytes, and the addition of a dual RX02 floppy disk drives and a RL02 hard disk drive. These new drives are available for transporting large volumes of data from the Laboratory's small computers to VAX. The arrival and installation of Defense Data Network (DDN) hardware added another enhancement to the central computer's communications capability.

The software capabilities of VAX also were expanded and improved during FY 86. Laboratory researchers, administrators, and their supporting staffs had access to the most current version of several programming languages (COBOL, BASIC, FORTRAN), word processing software (CT*OS), spreadsheets (CALC-11), statistical analysis and graphics packages (BMPD, SPSSGRAPHICS), and several other commercially available software packages that supported USAARL computing needs. In addition, the branch programming staff developed several software utilities during this period to facilitate the computing work done by the Laboratory's scientists and engineers.

One of the branch's major accomplishments in FY 86 was the accreditation of the central computer for storage and processing of highly sensitive information. This accreditation has allowed our investigators to use the computer to support their research in areas that require the acquisition and processing of such sensitive information.

Also, the branch designed and implemented Aircraft In-flight Monitoring System (AIMS) processing and analysis software. This one-of-a-kind system was built with the assistance of the branch programmers, and was an essential element of one of the Laboratory's major research projects of this period, the atropine study.

A refinement and expansion of the software supporting the Aviation Epidemiology Data Register (AEDR) continued. The database grew significantly during this period to 37,000 records from 7,500. The branch staff also were involved in developing procedural improvements during this expansion. This resulted in a system that can support research and operational needs.

The branch also accomplished the advanced planning, coordination, and development of software and data requirements for the UH-60 (Blackhawk) simulator which is expected to be delivered to USAARL by FY 88. Programming and analysis support for several other Laboratory research projects were provided. These include the contact lens study (CICLOPS), the heat stress study, and the free field impulse noise study.

Products produced:

Publications:

"Effects of chemical defense antidotes (atropine) on aviator performance." Proceedings of the 30th Annual Meeting of the Human Factors Society, September 1986.

Technical and Logistical Services Division

The Technical and Logistical Services Division provides total support to the Laboratory through Scientific Arts, Laboratory Crafts, Supply and Acquisition, Facilities Engineering and Maintenance, Equipment Maintenance, and Property Management branches. By its support in the areas of planning, coordinating, and implementing technical, logistical, and maintenance programs, the division contributes to the Laboratory's research mission.

Facilities Management

All of the facility's maintenance planning and new construction are monitored by the building engineer. He assists in the approval, planning, design, and modification of facilities. The building engineer also supervises and inspects all such work.

FY 86 was the fourth full year of facilities contract maintenance where contractors provided outstanding work under the guidance of the building engineer. This service agreement is the first of its type at Fort Rucker. Representatives of the facilities management office have supervised the correction of construction deficiencies and malfunctions, as well as the installation of new equipment items.

Work has recently been completed on the new vivarium and acoustics facility. Construction now underway is for the installation of a new simulator, a logistics area, and an elevator. Work with the Directorate of Engineering and Housing and Directorate of Contracting is underway by Facilities Management to obtain a new maintenance and custodial contract for the out years.

Property Management Branch

The Property Management Branch acquires and maintains control of all expendable and nonexpendable supplies for USAARL through checks, labeling, and hand receipts of all incoming equipment required in support of the Laboratory's mission. It also monitors the excess equipment program, the turn-in of equipment, and other equipment gains or losses, and ensures that durable supplies are handled in an efficient and cost-effective manner.

Ending FY 86, the value of the USAARL property book was \$16,217,430. This inventory included 2,908 lines with 7,079 items. The command emphasis on property accountability was evident by the increased awareness by hand receipt holders of their responsibilities in safeguarding U.S. Government property.

A significant element in the FY 86 command supply inspection and a Department of the Army area of special interest was verification of the property account inventory accuracy. USAARL's was determined to be 100 percent for the fifth straight year.

Scientific Arts Section

The Scientific Arts Section of the Technical Services Branch provides the scientific and technical photography, medical and scientific illustration, engineering drafting, video and motion picture data collection and documentation, projection service for scientific presentations, and related audiovisual services for USAARL.

The photographic personnel use automatic processing equipment to provide the research support for USAARL investigators. Many illustration and drafting hours were saved by using a computer graphics system to produce slides and negatives.

This section produced over 22,000 units of still photographic work, nearly 3,000 feet of motion picture film, over 17,600 minutes of video tape, and over 2,600 units of graphics arts work in support of research projects in FY 86.

Laboratory Crafts Section

This section of the Technical Services Branch plans, designs, and fabricates intricate and commercially unavailable and specific scientific equipment, tools, and fixtures to meet the special needs of specific research project demands. Its personnel are technically proficient in identifying and understanding and meeting the researchers' needs.

The shop personnel continue their support by processing items necessary to meet the research needs. Among the items requiring special work are: components for the cooling vest study; support of the atropine project and body armor study; design and fabrication of camera, antenna, and equipment component mounts; the manufacture of animal restraints and positioning devices, and modification and fabrication of many other miscellaneous devices in support of on-going research efforts.

Maintenance Branch

Maintenance personnel completed in excess of 350 work orders during FY 86. Its personnel provide maintenance, repair, and calibration of all property (excluding aircraft) in the Laboratory. Performance of maintenance is provided by one or more of the following: in-house support, post intracontracts, one-time support contracts, or continuing service contracts. This branch maintains historical data on all equipment, monitors items under the Army warranty program, and provides technical information needed for procurement. Branch personnel have technical knowledge of laboratory equipment, as well as being knowledgeable of how the equipment relates to the research efforts.

Supply Branch

The Supply Branch prepares and submits purchase orders for nonstandard supplies and equipment with proper authorization and justification. It also requests, sorts, and issues all standard

and nonstandard supplies. This branch acts as the technical liaison between researchers and the Fort Rucker procurement office for establishing high-dollar contracts to support the USAARL research mission.

Supply personnel assist USAARL's researchers in composing justification for purchasing equipment and supplies. The Mission Support Supply Account, a formal account that allows for bypass of standard procedures, also is managed by the Supply Branch. The Supply Branch operates a self-service account and maintains and conducts searches utilizing literature, catalogs, and supply requisitions.

From the warehouse area, expendable supplies may be acquired, as well as other small items requested. Large and heavy items are delivered to the research divisions by personnel of the Supply Branch. During FY 86, over 1,000 purchase requests were submitted, of which a large percentage required special handling.

When required, USAARL's Supply Branch is responsible for procurement of controlled drugs from Medical Supply, Lyster U.S. Army Community Hospital; the accountability for the drugs; and the issue to the USAARL Controlled Substance Officer.



Program Funding FY 84-85-86
(Thousands of Dollars)

FY	6.1 Basic Research	6.2 Exploratory Development	6.3 Advanced Development	6.5 Management Support	Reimbursable	Total
84	757.0	5388.0		44.0	73.0	6262.0
85	953.0	5344.0	699.0	289.0	105.0	7360.0
86	492.0	4909.0	453.0	121.0	130.9	6105.9

Funding

Contracts

The U.S. Army Medical Research and Development Command (USAMRDC) supports research performed by universities and businesses which parallels the research requirements of the laboratories under the USAMRDC command. Because of the scientific manpower constraints of the U.S. Army, this program provides not only the research data needed, but the scientific expertise in a cost effective manner. In FY 86, this laboratory received 22 extramural research proposals; six were favorably reviewed, but because of current funding constraints, only two new starts were funded. Status of all ongoing contracts follows:

TITLE: Auditory evoked potentials as a function of sleep deprivation and recovery sleep

CONTRACT NO. DAMD17-84-C-4084

CONTRACTOR: Bowling Green State University
Bowling Green, Ohio

INVESTIGATOR: P. Badia

Objective:

To determine if P300 neurophysiological events are sensitive to sleep deprivation (48 hours); to determine the correlation of P300 events with traditional psychological/psychomotor events; and to document the restorative effects of short sleep on P300 events and traditional measures. This information will determine if this new and controversial technology should be evaluated in the Army's field setting as a means of monitoring and predicting sleep deprivation associated performance and decision-making decrements.

Progress:

Both Bowling Green State University and University of Southern Mississippi have completed the test protocol under the terms of this contract. The research has been established to attempt to investigate the correlation of central nervous system (CNS) shifts to sleep deprivation, and the influence of recovery sleep to return any CNS shifts to normal. A draft final report

is being reviewed. Conclusions from the research indicate that sleep deprivation has a marked effect in cortical evoked response; and these responses tend to correlate to performance shifts. Such results are encouraging in that such CNS measures could be refined to become a benign method of predicting aviator performance degradation prior to actual failure. Contract complete.

TITLE: Computer modeling and optimization of OBOGS with contaminants

CONTRACT NO. DAMD17-83-C-4076

CONTRACTOR: University of Texas at Austin,
Austin, Texas

INVESTIGATOR: J. J. Beaman

Objective:

To develop a computer model of molecular sieve oxygen generation systems which includes bed temperature variation, altitude (pressure changes), and effects of contaminants. This model can be used to optimize Onboard Oxygen Generation Systems (OBOGS) for use in helicopter, MEDEVAC, and field hospitals. The model should run on U.S. Army Aeromedical Research Laboratory computers, VAX or PDP 11/24.

Progress:

A simple, three-component model using uncoupled linear isotherms has been developed but not yet tested due to a lack of data. Also, the two component model for oxygen-nitrogen has been modified to include a power law correlation for the parameters in the isotherm expressions. While this correlation is entirely empirical, it improves performance of the model at low temperatures. The model currently is being rewritten and generalized for three components with general isotherms using a new equilibrium model. Contract completed; in-house experiments continue at University of Texas.

TITLE: Continuing support of the ASA Standards Program

CONTRACT NO. DAMD17-83-G-9545

CONTRACTOR: Acoustical Society of America,
New York, New York

INVESTIGATOR: A. Brenig

Objective:

To maintain accurate standards in acoustics, coordinate technical expertise to provide U.S. positions and inputs to international standardization efforts and documents, and coordinate U.S. representation to international meetings in acoustical standardization and subcommittee and working group meetings.

Progress:

Three accredited standards committees, S1, S3, and S12, were administered during this period. Semiannual committee meetings of each committee were held. Working groups under each committee have continued the process of preparation, review, and revision of standards within their charter. Coordination of various International Standards Organization (ISO) standards has yet to be accomplished.

TITLE: Effects of altitude and oxygen supplementation
on high level cognitive performance and psycho-
motor skills

CONTRACT NO. 85PP5817 (intra-Army funding)

CONTRACTOR: Tripler Army Medical Center,
Tripler AMC, Hawaii

INVESTIGATOR: W. Coussens

Objective:

To establish the relationship between levels of hypoxia and ability to perform complex cognitive and psychomotor tasks. To further establish the relationship between IQ scores and the ability to perform under conditions of reduced partial pressures of oxygen. To assess the effect of changing performance by providing supplemental oxygen.

Progress:

No report received by this Laboratory. Contract terminated.

TITLE: The evaluation of mammalian inner ears for noise induced pathologies

CONTRACT NO. DAMD17-86-C-6139

CONTRACTOR: State University of New York (SUNY)
Plattsburg, New York

INVESTIGATOR: R. Hamernik

Objective:

To perform precision morphometric analysis of cochlear tissues following exposure to noise and to ultimately correlate these anatomical data with hearing performance measures obtained from the same animal.

Progress:

A paper describing the relationship of intensity and number of impulses was submitted for publication in The Journal of Acoustical Society of America. This paper concludes that intensity and number of exposures can be traded on an energy basis. A paper was presented at the "Blast Injuries of the Ear" Seminar at Walter Reed Army Institute of Research (WRAIR) describing the middle ear damage and cochlear pathology of animals exposed to blast behind armor. The results indicate that significant cochlear injury is associated with blast levels which rupture eardrums. Evaluation of chinchilla cochleas from a study of the effects of impulse spectral content on hearing loss has continued.

TITLE: The effects of blast trauma (impulse noise) on hearing: A parametric study

CONTRACT NO. DAMD17-86-C-6172

CONTRACTOR: State University of New York (SUNY)
Plattsburg, New York

INVESTIGATOR: R. Hamernik

Objective:

To develop a broad database from which to estimate the hazards to hearing, resulting from exposure to blast waves or other high level impulse noise.

Progress:

Two valve operated shock tubes which produce impulse noise with different spectral characteristics have been assembled and are now functional. A computerized impulse noise data acquisition and analysis system has been completed. Experiments to explore the relationship of intensity, number of impulses, and time between impulses are under way.

TITLE: Filtration of chemical warfare agents in U.S. aircraft oxygen generation systems

CONTRACT NO. DAMD17-85-C-5013

CONTRACTOR: AiResearch Manufacturing Company
Torrance, California

INVESTIGATOR: J. McDonnell

Objective:

To produce the basic data required for an understanding of the chemical agent adsorption/desorption mechanisms of materials for oxygen concentration and establish the useful life of current molecular sieve oxygen concentrator (MSOC) units when utilized in a chemical warfare environment. The potential exists for establishing technology that will allow the MSOC to be a dual-purpose unit, providing both oxygen-enriched breathing gas and protection from CW agents.

Progress:

The final report indicates that appreciable chemical agent adsorption should be expected with molecular sieve material and that the material is at least partially regenerable. Different in pore size of sieve materials apparently is responsible for the variation in regenerability between the two materials tested. It is postulated that while 13X material may provide protection from CK indefinitely, it should be replaced after exposure to nerve agents. The 5X material is not very regenerable and would require an additional filter, although providing protection initially for up to 17 hours. Contract completed.

TITLE: The personal monitor and communicator (PMC)

CONTRACT NO. DAMD17-85-G-5021

CONTRACTOR: Purdue Research Foundation
West Lafayette, Indiana

INVESTIGATOR: W. Tacker

Objective:

Based on work accomplished under previous contract, research continues towards developing the wristwatch version of the personal monitor and communicator vital signs monitor. Goals will include the miniaturization of the existing breadboard version of the PMC and a demonstration of the following functions: casualty location, casualty interrogation, and vital signs data acquisition. A central control station also will be developed; this station will incorporate the triage algorithm and data display software.

Progress:

Developed a brassboard prototype system for remote triage and location of casualties on the battlefield. The system includes sensors worn on the wrist of each soldier to determine responsiveness, motion, heart rate, and respiration. A computerized rule-based system at a central station uses these data to triage soldiers into categories of (1) functional, (2) wounded, but stable, (3) needing immediate evacuation, (4) alive, but fatally wounded, and (5) dead. Menu-driven software for the rule-based expert system resides in a laptop computer at the central station upon which soldiers' triage categories and locations are displayed graphically.

TITLE: National Academy of Sciences Committee on Hearing, Bioacoustics and Biomechanics (CHABA) and Committee on Vision

CONTRACT NO. MIPR 85MM5504 (interservice funding)

CONTRACTOR: Department of the Navy
Arlington, Virginia

INVESTIGATOR: M. Whitcomb

Objective:

To provide independent, objective scientific advice and technical information regarding basic and applied problems in the areas of vision, hearing, and biomechanics. To respond to questions and requests of a specific nature, and to provide long-term continuing support in areas of recurring interest.

Progress:

The Committee on Hearing, Bioacoustics, and Biomechanics prepared draft reports on brainstem audiometry of prelanguage groups and noise and vibration criteria for the space station; published a working group report titled "Electronic Travel Aids: New Directions for Research." The Committee on Vision held exploratory meetings on Advances in Instrumentation for Vision Research and Changes in Vision During Long-Term Space Flight; prepared a draft working group report on "Myopia Prevalence and Progression"; held a 2-day conference on work, aging, and vision; and prepared an executive summary of the recommendations of the working group on night vision.

TITLE: Contributive research in soldier performance, performance assessment methodology, analytic and modeling systems, and performance data measurement (task order contract)

CONTRACT NO. DAMD17-86-C-6215

CONTRACTOR: Universal Energy Systems (UES)
Dayton, Ohio

INVESTIGATOR: J. Christensen

Objectives:

Task Order #1, Aviator Performance Effects of Chemical Warfare Antidotes (atropine). To determine the performance and physiological effects of ADP on aviators. Task Order #2, Aviation Epidemiology Data Register. To develop an automated database system for all Army aviator medical and health/safety related information that will provide an accurate source of epidemiologic data for aviation medical selection/retention/-waiver standards and efficient record access/health tracking to medical users.

Progress:

Task Order #1: UES began a critical literature review and anticipates final report by next quarter. A draft of the Standard Operating Procedures (SOP) for Apple II, FPS, and VAX computer programs have been submitted for review. Completed a review of the current data file stored in the VAX for SPSSx data analysis, and found that the need for modifications are minimal since Information Management Group (IMG) already had corrected many previously identified problems. UES is to serve as the data collection, reduction, and analysis team for the Atropine II study and now is fully trained with equipment, procedures, and

checklists ready to begin. Task Order #2: Database data is being collected at rates of long-term operational levels; currently inputting 900-1000 records per week. System bugs, medical coding problems, and inconsistencies have been reduced greatly. Transition to a consolidated data collection system has been made. Contract data transcribers are on site and being trained. Software is being written to allow double entry verification of data.

Small business innovation research

Each year, in compliance with the Small Business Innovation Development Act of 1982, the Department of Defense (DoD), through its subordinate agencies and commands, invites small business firms to submit research proposals for funding consideration. The Small Business Innovation Research (SBIR) program is directed at providing encouragement for small firms in the private sector to accomplish contracted efforts relevant to DoD needs. During FY 86, USAARL reviewed 13 SBIR proposals and 5 of them were funded. Status of all SBIR programs at USAARL follows:

TITLE: Development of a test battery for assessment
of human performance

CONTRACT NO. DAMD17-85-C-5095

CONTRACTOR: Essex Corporation
Orlando, Florida

INVESTIGATOR: R. Kennedy

Objective:

To develop a menu of tests for assessment of human performance. To publish a menu of tests which can be accessed by a test administrator. This menu will exhibit the various metric properties of each test, but also will aid in permitting tradeoffs to be made between the several chief constraints to field testing of performance, thereby permitting experimental designs from the standpoint of statistical power and engineering costs. These considerations will include testing time, reliability/per unit of time, time to stabilization, subject time, and number of factors tested.

Progress:

Continuing review of tests and test batteries and applying criteria to identify test overlap so that tests with unique variance and expected factor richness can be selected for early study. Further software documentation on the new PAB is expected from researchers at Walter Reed Army Institute of Research which will be implemented as well as four programmable vision tests.

TITLE: Miniaturized pocket portable defibrillator
CONTRACT NO. DAMD17-85-C-5061
CONTRACTOR: Bioelectronics
Laguna Niguel, California
INVESTIGATOR: H. Barcikowski

Objective:

Demonstrate the feasibility of developing a high capacity, high rate energy source in a small unit volume. An additional objective will be to develop the required electronic control circuitry to deliver the precise pulse duration and wave form.

Progress:

The research performed under this Phase I project, successfully demonstrated the technical feasibility of a miniaturized portable DC defibrillator. Contractor has submitted a proposal for Phase II which will encompass the development of an engineering model of the proposed defibrillator.

TITLE: In-the-ear talk-through hearing protection
CONTRACT NO. DAMD17-85-C-5035
CONTRACTOR: Sensor Electronics, Inc.
Mount Laurel, New Jersey
INVESTIGATOR: J. Langberg

Objective:

To develop a personal hearing protector in the form of an earplug with design emphasis on comfort, high attenuation, and voice received communication capability.

Progress:

The first round design of an active earplug consisting of earphone transducer imbedded in a flanged plug was fabricated. Design or selection of electroacoustic transducers and other components was begun. The design of the laboratory test setup was completed and fabrication has been initiated.

TITLE: Novel multisensor chemical detector

CONTRACT NO. DAMD17-85-C-5045

CONTRACTOR: High Technology Sensors, Inc.
Longwood, Florida

INVESTIGATOR: R. Mindock

Objective:

To develop a chemical detector capable of operation on the ground or in an airborne mode that will profile toxic gases encountered in the immediate environment. Gases to be identified include, but are not limited to the following: Ammonia, carbon monoxide, total hydrocarbons, hydrogen chloride, and nitrogen oxides.

Progress:

Source devices were fabricated using the new technique and approximately the same optics which will be incorporated in the final source. The devices were characterized at different wavelengths and with different pulse conditions. The optics provided the anticipated optical signal improvements. Characterization work on the electronic filters and amplifiers was completed. Work has begun on the overall design of the system as well as on the mechanical portions of the gas sensing system.

TITLE: A multisensor chemical detection and measurement system

CONTRACT NO. DAMD17-85-C-5062

CONTRACTOR: Environmetrics, Inc.
St. Louis, Missouri

INVESTIGATOR: E. Scheide

Objective:

To develop a chemical detector capable of operation on the ground or in an airborne mode that will profile toxic gases encountered in the immediate environment. Gases to be identified include, but are not limited to the following: Ammonia, carbon monoxide, total hydrocarbons, hydrogen chloride, and nitrogen oxides.

Progress:

Work has been started on a breadboard model of the proposed analyzer. Decisions have been made concerning the power availability, battery options, operating temperature ranges, humidity, vibration levels, altitudes, maximum size, modular configuration, sampling techniques, mode lights, crew-instrument interface, time markers, and desired format for data.

TITLE: Design and development of the interim and final psychology assessment system for USAMRDC

CONTRACT NO. DAMD17-85-C-5032

CONTRACTOR: Information Management Group, Inc.
Satellite Beach, Florida

INVESTIGATOR: C. Young

Objective:

To expand the current conceptual design of a field portable electronic clipboard to a final operational system capable of providing psychological test batteries such as PAB, PETER, SWAT, and subjective questionnaires for utilization in a military environment.

Progress:

Initial hardware design review has been conducted. Resulting from the initial review, the contractor was to propose the trade off hardware design considerations to develop a final system capable of operating the UTC-PAB software.

Customer-funded Projects

In direct compliance with our mission to conduct research and development to eliminate health hazard associated with military manned systems and to assist combat mission planners and materiel developers to recognize these hazards early in the developmental process, USAARL maintains a program of active research and consultation with doctrine and materiel development agencies. This problem-solving research program allows Laboratory personnel to apply their specific research expertise to emerging systems, thus providing vital support to developers who do not possess in-house personnel qualified to conduct such research. These customer-funded research projects, while serving the requesting agency, also allow USAARL to increase the information base within the established scientific research programs.

There were 13 customer-funded projects in FY 86 -- 3 brought forward from FY 85 and 10 new projects. The projects, funding agencies, and brief progress are detailed.

TITLE: Instrumented anthropomorphic dummies for airdrop testing

FUNDED BY: Yuma Proving Ground, Yuma, Arizona

INVESTIGATOR: Joseph L. Haley, Jr.

Objective:

(1) To measure the torso decelerations of dummies when paraded from C-130 aircraft at airspeeds of 150-250 Kt at 500 AGL, (2) to evaluate the above dummy decelerations relative to the known human tolerance to such impact, and (3) to provide a tentative release to allow further military volunteer experimental parachute jumps under the conditions stated in Objective (1).

Progress:

"Medical and Physiological Issues" input were completed by a USAARL flight surgeon in July. Engineering development continues. However, the TECOM test plan has not been rewritten. The John F. Kennedy Center has not yet defined minimum contact

speed requirement. The test and evaluation cannot continue until the user formally requests the sink speed change. Terminated as reimbursable.

TITLE: Engineering support of the Army integrated flight helmet (HGU-56)

FUNDED BY: Aviation Systems Command (AVSCOM)
St. Louis, Missouri

INVESTIGATORS: Joseph L. Haley, Jr. and Ben T. Mozo

Objective:

To provide design criteria as needed/required during the contractor development phase of the HGU-56.

Progress:

The headform with which to test the crushable earcup was received in September 1985. The prototype helmet evaluation report still awaits delivery of final prototypes for impact, retention, and compatibility testing.

TITLE: U.S. Army motorcycle helmet evaluation

FUNDED BY: U.S. Army Natick Research and Development Laboratory, Natick, Massachusetts

INVESTIGATORS: Joseph L. Haley, Jr. and Ben T. Mozo

Objective:

To provide design criteria and evaluation as needed and/or required.

Progress:

Project awaits completion of field tests before next in process review.

TITLE: Calibration of headsets for Weaponer training device

FUNDED BY: Office of the Project Manager for Training Devices, Orlando, Florida

INVESTIGATOR: Ben T. Mozo

Objective:

To provide calibration data, including sensitivity, impedance, and frequency response characteristics, of 115 headsets furnished by Spartanics, Ltd.

Progress:

The measurement of acoustical characteristics has been completed. Analysis and summary of findings have been completed and forwarded to PM TRADE.

TITLE: Visual evaluation of the AH-64 protective mask (OT II)

FUNDED BY: Aviation Board,
Fort Rucker, Alabama

INVESTIGATORS: John K. Crosley, Clarence E. Rash, Isaac Behar,
and David Walsh

Objective:

To perform an evaluation of the visual characteristics of AH-64 Protective Mask (OT II).

Progress:

Evaluation completed and findings published in USAARL LR 87-4-2-3, Visual Performance with the AH-64 Protective Mask.

TITLE: LHX research project team

FUNDED BY: Project Manager Light Helicopter Family,
St. Louis, Missouri

INVESTIGATORS: Douglas Landon, William Burgin, J. D. LaMothe,
and Michael Sanders

Objective:

Participate in the multiagency trade-off analysis and the Advanced Rotorcraft Technology Integration (ARTI) effort. To identify deficiencies in the science base and recommend research needs to eliminate these deficiencies.

Progress:

Attended ARTI program reviews and participated in LHX senior advisory reviews at AVSCOM and Fort Eustis. Provided aeromedical consultation on potential health hazard issues.

TITLE: HGU-56 engineering support

FUNDED BY: Aviation Systems Command
St. Louis, Missouri

INVESTIGATOR: Joseph L. Haley, Jr.

Objective:

To provide HGU-56 flight helmet evaluation as requested.

Progress:

The expected helmet was not received. An internal evaluation to align the HGU-56 requirements to coincide with those of the LHX has begun. A new direction is expected on this program. Program delayed.

TITLE: Whole-body vibration (WBV) health hazard assessment (HHA) data collection and analysis for the Counterobstacle Vehicle (COV)

FUNDED BY: Belvoir Research and Development Center,
Fort Belvoir, Virginia

INVESTIGATORS: Barclay P. Butler and Roy Maday

Objective:

To gather sufficient WBV data on the COV to perform a HHA IAW AR 40-10.

Progress:

Data acquisition using the Multiaxis Vibration Simulator (MAVS) is complete. Data analysis is awaiting the completion of the automated analysis program for vibration HHAs.

TITLE: Sound attenuation characteristics of SPH-4 helmet

FUNDED BY: Defense Logistics Agency Defense Personnel
Support Center
Philadelphia, Pennsylvania

INVESTIGATORS: Ben T. Mozo, William Nelson, Barbara Murphy,
Elmaree Gordon, and Linda Barlow

Objective:

Measure real ear and physical ear attenuation of SPH-4 helmet manufactured by Bell Helmets, Inc.

Progress:

Results have been provided to DPSC. Project complete.

TITLE: Noise attenuation testing of SPH-4 helmet

FUNDED BY: Defense Logistics Agency Defense Personnel
Support Center
Philadelphia, Pennsylvania

INVESTIGATORS: Ben T. Mozo, William Nelson, Barbara Murphy,
Elmaree Gordon, and Linda Barlow

Objective:

Measure real ear and physical ear attenuation of SPH-4 helmets manufactured by Safetech, Inc.

Progress:

Results have been provided to DPSC. Project complete.

TITLE: Health hazard assessment of the impulse noise produced by the Vulcan Wheeled Carrier

FUNDED BY: Combat Developments Experimentation Center
Test Board,
Fort Lewis, Washington

INVESTIGATORS: Ben T. Mozo and James H. Patterson, Jr.

Objective:

The measurement of impulse noise produced by the Vulcan Wheeled Carrier (VWC) at various angles of azimuth and elevation of the gun. These data will be used to develop a health hazard assessment of the VWC.

Progress:

Data collection completed at Yakima Firing Center, Washington. Data analysis completed. Report in progress.

TITLE: Evaluation of prismatic deviation techniques
FUNDED BY: Natick Research and Development Center,
Natick, Massachusetts
INVESTIGATORS: Clarence E. Rash

Objective:

To evaluate currently used techniques to measure vertical and horizontal prismatic deviation in optical media (e.g., lenses, visors, windscreens, etc.)

Progress:

Performed investigation and provided guidance and recommendations to Natick. Report prepared; project completed.

TITLE: Energy absorbing "crushable" earcups
FUNDED BY: Natick Research and Development Center,
Natick, Massachusetts
INVESTIGATORS: Joseph L. Haley, Jr. and Ben T. Mozo

Objective:

Evaluate earcups for impact, acoustic, and operational wear.

Progress:

Earcups were installed in SPH-4 helmets and evaluated as requested. Project completed; report provided to Natick.

Personnel Strength

	Officer	WO	EM	Civilian		Co-Op	Student	Total
				Perm/Temp	Students	Aides		
FY 84 Authorized Actual	26	1	46	69	12			154
	28	1	50	62	9	3		153
FY 85 Authorized Actual	26	1	45	68	2			142
	26	1	40	63	13	2	2	147
FY 86 Authorized Actual	25	1	43	65	2			136
	25	2	46	67	11	0	0	151

Personnel

USAARL continued to support the upgrading of its personnel. Sixty-five military and 112 civilian training and professional development experiences were given during FY 86.

The personnel at USAARL have earned 22 doctorates, 6 doctors of medicine, 21 masters, and 23 bachelors degrees.

Category	Authorized
Professional	54
Scientists (41)	
Engineers (4)	
Others (9)	
Skilled technicians	44
Administrative	18
Clerical	20
 TOTAL	 136

Awards

Civilian exceptional ratings/performance awards

Exceptional Performance ratings.....	50
Merit Pay Cash Award.....	8
Performance Award.....	10
Special Act or Service Award.....	11
Quality Step Increase.....	1
Certificate of Achievement.....	3

Military awards

Army Commendation Medal.....	14
Army Achievement Medal.....	11

Military promotions

Officers.....	6
Enlisted.....	10

Civilian promotions

Permanent.....	10
Temporary.....	2

Special recognition

USAARL NCO of the Year..... SGT Rosalinda Ibanez
USAARL Soldier of the Year... SP4 Douglas Baer

Co-op Program

Co-Operative Education Program. Due to limitations on hiring, the Co-Op program had no new requirements for FY 86.

Three students were in Co-Op roles at USAARL in FY 86. One of these was an undergraduate and two were graduate students. Requirements existed for the following job series: research psychologist and electrical engineer.

During FY 86, the following universities were represented by Co-Op students: Clemson University, the University of Alabama, and Florida State University.

Two Co-Op students competed for permanent positions and were hired in FY 86. Both were research psychologists.

Junior Fellowship Program

Junior Fellowship Program. The Junior Fellowship writer-editor trainee worked during the summer and during holidays. She was promoted to GS-3 in accordance with regulations. She continued her formal education at Vanderbilt University.

Federal Women's Program

USAARL has an active Federal Women's Program (FWP) headed by a Federal Women's Program Manager (FWPM) and an alternate FWPM. The FWPM and alternate provided information on the Upward Mobility Program, the Federal Discrimination Complaint Process, Functions of the Federal Women's Program and Federal Women's Program Committee, and other issues affecting employment, training, and recruitment opportunities to women employed at USAARL. The USAARL FWPM was appointed by the Commander, USAARL, and served as his staff adviser on matters affecting women. The FWPM duty was and remains a collateral duty assignment.

USAARL's FWPM was a member and the Recorder of the Federal Women's Program Committee (FWPC) for the Commanding General, Fort Rucker, Alabama. This committee provided the Commanding General with advice and information regarding issues affecting the FWP and the female employees in the Fort Rucker work force, produced a statistical study of the status of women at Fort Rucker, proposed a plan of action for the Upward Mobility Program, and

provided FWP input for the Installation's Affirmative Action Program. During the past year, the FWPC cosponsored training in Decision Making, PEP for Working Women, Effective Presentations, Preparing the 171/201, Pay Equity, Career Week, Employee/- Supervisor Luncheon, an essay contest for the elementary school children during Women's History Week, and participated in American Heritage Week.

Individual Mobilization Augmentation (IMA) Program

The USAARL IMA Program has 13 designee positions, including allied science officers, medical officers, aviators, and combat arms officers. Five of these positions were filled during FY 86. USAARL has candidates for an additional position that has not been confirmed.

Technology transfer

Provisions of the Stevenson-Wydler Technology Act of 1980 (PL 96-480) continued to be implemented during FY 86. Representatives were sent to Federal Laboratory Consortium meetings. USAARL's Office of Research, Technology, and Assessment (ORTA) representative functions as Deputy Director Southeastern Region, Federal Laboratory Consortium.

More than 150 requests were received by the Scientific Information Center (SIC) for either information or copies of bibliographies or technical reports. The SIC also provided technical services for all of the Aeromedical School activities and training at Fort Rucker.

Equal Employment Opportunity (EEO) Program

Affirmative action continued to be emphasized at USAARL. During FY 86, accomplishments included the following:

Black employees

The total number of Black permanent employees increased by one, with the gain of one GS-5 (PP9) Black female psychology technician. Total representation rose to 9 percent from 6 percent. Average grade for Black employees is GS-8. New hires include one GS-5 (PP9) Black female. One Black male was promoted to GS-9 from GS-7, and one Junior Fellowship Black female was

promoted to GS-3. An Exceptional Performance Award was given to one Black male and two Black females. One Black male received a Special Act Award. Two local training courses were given to Black employees and eight training courses involving TDY were given to Black employees. There were no disciplinary actions taken against Black employees.

Hispanic employees

There was a gain of one Hispanic employee with the hiring of a GS-11 research psychologist. Average grade rose to GS-10 from GS-9. One Exceptional Performance Award and one Special Act Award were given to a Hispanic employee. One local training course and one training course involving TDY were given to Hispanic employees. The number of Hispanic employees is two, or 3 percent.

Women employees

Total number of women employed changed by -2 to 28 or 44 percent. Average grade for women was 6.4. Two white females were promoted to GS-6, one white female was promoted to GS-5, and one Black female Junior Fellowship student was promoted to GS-3. There were three temporary promotions to GS-6. Twenty-two females received Exceptional Performance ratings, six received Special Act Awards, six received Sustained Superior Performance Awards, and two received a Certificate of Achievement. A total of 90 training courses were completed by female employees with 38 being taught locally and 52 training courses involving TDY. There continues to be underrepresentation of women at the professional level and above the GS-12 level.

Handicapped employees.

USAARL has two permanent handicapped employees. No handicapped personnel were referred, so there were no opportunities to select.

Scientific seminars

USAARL sponsored four scientific seminars during FY 86 at the Laboratory's facilities. These seminars were given by subject matter experts performing research in areas that coincide with USAARL research efforts.

Benefits included transfer of information, cross-training for the research staff, and interaction with the research staff on primary research efforts. The seminars were open to the public; numerous persons from the scientific community unrelated to the Laboratory attended these seminars.

The following is a list of speakers, their topics, and the dates of their seminars.

Dr. Robert Linsenmeir, Department of Neurobiology and Physiology, Biomedical Engineering Division, Northwestern University, Evanston, Illinois, spoke on "Effects of hypoxia on retinal function" on 31 March 1986.

Dr. Michael Thomas Shipley, professor, Department of Anatomy and Cell Biology, University of Cincinnati College of Medicine, discussed "Forebrain cholinergic circuits: Targets for chemical warfare agents" on 22 April 1986.

Dr. Richard Snyder, president of Biodynamics International, Ann Arbor, Michigan, spoke on "The status of civil aircraft crashworthiness findings" on 19 June 1986.

Dr. James E. Newman, director of engineering, Biokinetics and Associates, Inc., Ottawa, Canada, discussed "Head injury criteria and their relation to helmet design, testing, and performance" on 29 July 1986.

Scientific programs

The following DA Task Areas are being supported by this Laboratory:

Task	AMSCO	Title	Division*
91C00	611101	ILIR	BARD/SRD
S10CB	611102	Sensory physiology	SRD
875AO	612734	Visual system effects of antidotes and chemical agents	SRD
878AA	612777	Auditory effects of blast overpressure	SRD
878AC	612777	Noise hazards of combat vehicles	SRD
878AD	612777	Vibration hazards of combat vehicles	BRD
878AF	612777	Crew life support biotechnology	BARD
878AG	612777	Biodynamics of life support equipment and personnel armor	BRD
879BG	612777	Sensory enhancement and limitation of individuals and systems	SRD
879BI	612777	Artificial intelligence and robotics	SRD
879BH	612777	Biomedical aspects of crew workload, selection, and staffing	BARD/BRD
995AG	623764	Pilot performance assessment of therapeutic compounds	BARD

*BARD: Biomedical Applications Research Division
SRD: Sensory Research Division
BRD: Biodynamics Research Division

Technical participation

A. ILIR

1. DA300426, 293 Development of techniques to monitor brain function of aviators during flight in Army fixed- and rotary-wing aircraft
2. DA306075, 295 Aviation physiologic and epidemiologic database
3. DA306804, 296 Concept study of closed-loop medical expert systems
4. DAOH0152, 291 Development of military/ASTM standard method for rapid assessment of burn hazard

B. Sensory physiology

1. DAOG5999, 283 Physiology and psychophysics of information transfer in the visual system
2. DAOB6889, 282 Military acoustic hazards: Mechanisms of hearing loss

C. Visual system effects of antidotes and chemical agents

1. DAOG8399, 381 Antidote and antidote/agent effects on the visual system

D. Auditory effects of blast overpressure

1. DAOG5998, 136 Auditory effects of blast overpressure

E. Noise hazards of combat vehicles

1. DAOB6886, 135 Hearing protective devices: Prevention of adverse physiological effects of noise

F. Vibration hazards of combat vehicles

1. DAOG6100, 132 Vibration hazards of combat aircraft and vehicles

- G. Crew life support technology
1. DA307869, 139 Army program for testing and evaluation of aeromedical equipment
 2. DAOG0165, 133 Research countermeasures for significant medical hazards in military systems
 3. DAOG0169, 134 Biomedical application and health hazard assessment of oxygen enrichment breathing systems
- H. Impact biodynamics of crashworthiness and personnel armor
1. DA302870, 138 Life support equipment crashworthiness evaluations
 2. DAOG0167, 131 Biodynamics of life support equipment and personnel armor
- I. Sensory enhancement and limitation of individuals and systems
1. DA306074, 168 Contact lenses in military environments
 2. DAOB6893, 164 Military visual problems: Assessment, mechanisms, and protection
- J. Artificial intelligence and robotics
1. DA304235, 167 Artificial intelligence and robotics: Biomedical applications
- K. Biomedical aspects of crew workload, selection, and staffing
1. DA306810, 169 Physiological and psychological effects of extended operations and NBC environments on combat vehicle crews (P2NBC2)
 2. DA308727, 170 Aviation epidemiology data register
 3. DAOG6102, 166 Anthropometric criteria for Army aviators

- 4. DAOG0151, 165 Aeromedical research of operationally significant problems in the Army aviation environment
 - 5. DAOG0156, 162 Visual performance research related to operational problems in Army aviation
- L. Pilot performance assessment of therapeutic compounds
- 1. DA304298, 101 Aviator performance effects of chemical warfare antidotes and pretreatment therapies

DD Form 1498 title: Life support equipment crashworthiness evaluations

Background:

The crashworthy performance of existing aviation life support equipment (ALSE) needs to be known prior to updating crashworthy design criteria. Once the hazards are identified, methods to eliminate them can be developed.

Objectives:

To identify impact injury mechanism of Army fliers, parachutists, and ground vehicle occupants, and to provide impact design criteria for new and existing life support equipment (LSE) for the above stated personnel.

Progress:

During FY 86, the Army's new prototype motorcycle helmet was tested for impact against 1975 Snell Foundation standards and approved for field testing.

The analysis of the UH-60 seat impact data was completed and a report was published by the University of Michigan. The data collected was used to help in rewriting MIL-STD-58095 and MIL-STD-1290.

Work continued on a "standard" aviator Department of Defense handbook.

The tests to determine the effect of defeating a .50 caliber impact into chest armor were completed; this project now is transferred to a new DD Form 1498 for FY 87.

Developmental tests were conducted on SPH-4 flight helmets and tankers' helmets.

The high speed, low level parachute development was monitored and human tolerance relative to jump position at parachute opening provided.

Products produced:

Publications:

Improved design criteria for crash helmets. USAARL Report No. 86-11.

A device to locate the center-of-mass of a helmet. USAARL
LR-85-5-4-1.

Potential health hazard issues for the light helicopter experimental (LHX): Initial health hazard assessment. USAARL
LR-86-1-3-1.

Presentations:

"UH-60 Crew Seat Comparative Impact Testing" given to the American Helicopter Society National Specialists' Meeting, Atlanta, Georgia, 7-9 April 1986.

DD Form 1498 title: Military visual problems: Assessment, mechanisms, and protection

Background:

The extreme lethality of the modern mid-to-high intensity battlefield is forcing changes in tactics, weapons, and personal protective equipment. Advancing weapons technology, along with doctrinal requirements for continuous operations (including nighttime operations), combine to produce stresses which threaten to exceed the capabilities and limitations of the soldier and thereby degrade crew performance. For example, the visual demands of night goggle vision flight may necessitate new vision selection and retention criteria, and the requirement for continuous operations may exceed the soldier's visual performance capabilities after extended periods of operation. The use of protective devices such as laser goggles, protective masks, and helmet visors threatens to disrupt crewmembers' visual performance.

The existing biomedical database regarding the visual performance effects of vibration, darkness, smoking, continuous operations, night vision goggles, protective masks, and similar stressors is inadequate for countering the potential threats to combat effectiveness. The nature, extent, and mechanisms of visual performance degradation are largely undefined, and the resulting impact on combat effectiveness has not been determined. Likewise, existing visual selection and retention standards for special career fields (e.g., aviators, antitank gunners) generally have not been empirically developed and validated.

The overall goal of this research program is the development of realistic measures to prevent compromised combat effectiveness due to impaired visual performance. These preventive measures will include exposure criteria, materiel design criteria, crew selection and retention criteria, and modified operational doctrine. A major intermediate goal is the establishment of a

new visual effects biomedical database sufficient to support development of such measures.

Objectives:

The major technical objectives of this research program include characterization and quantification of visual degradations produced by specific stress factors; identification and characterization of mechanisms underlying visual degradations; determination of the relationships between identified visual degradations and task performance; and development and validation of models for predicting the impact of specific visual degradations on combat effectiveness. Also included as objectives are development and validation of exposure criteria and/or materiel design criteria for selected stress factors; development and validation of selection/retention criteria and operational preventive measures for special career fields; and development of instrumentation for rapid, reliable measurement of selected visual performance parameters.

Progress:

A protocol was prepared and approved to investigate the chronic effects of smoking on dark adaptation among aviators. This experiment will involve measurements of absolute thresholds of smokers and nonsmokers. In addition, time to recover to maximum visual sensitivity following exposure to night viewing devices also will be determined and compared.

A preliminary multiagency test development plan has been established for a target acquisition predictor study (TAPS). The study will attempt to delineate visual, cognitive, demographic, and training predictors of superior target detection and identification in a field environment. A study protocol will be written following test site selection and test plan approval.

The USAARL polycarbonate spectacle lens study reached the milestone of 500 spectacles tested by Army aviators for wear with night vision goggles (NVG). Questionnaires have been returned by most participants and are being analyzed. A briefing to the Army Medical Department Technical Committee resulted in the decision to provide all aviators with polycarbonate lenses for 1 year with reassessment then.

The report of findings from the laboratory study of effects of cycloplegia on contrast sensitivity in aviator candidates was completed and was accepted for open literature publication in Aviation, Space and Environmental Medicine. The cycloplegia results of this study were confirmed in a large sample (n=106) clinical study, which also provided normative data for the aviator candidate population.

A literature review on smoking and soldier performance was completed under a contract monitored by USAARL personnel. This has been published as USAARL Report 86-13. A final white paper was prepared.

As part of the Laboratory's study on aviator performance effects of chemical warfare antidotes, the effects of 2 and 4 mg doses of atropine on visual contrast sensitivity were evaluated. Preliminary results were included in an Army Science Conference presentation.

In conjunction with OT II testing, visual evaluation of the XM-43 protective mask was completed. Results were published as a letter report.

With the increased emphasis on night fighting, there is a need for a low cost device for training purposes which simulates night vision goggles. The concept proposal for and prototypes of an AN/PVS-5 simulator were completed (USAARL Report No. 86-5). A protocol for visual and optical evaluations was completed. Multiagency planning for field evaluations of the simulators began.

In conjunction with the target acquisition predictor study, a visual survey database was initiated to provide planners current vision and visual skill status of personnel. A mobile vision laboratory was assembled and field tested. Data collection from 700-800 infantrymen will begin in the first quarter of FY 87.

Continued the support of the Lunar Light Level Calendar. Converted the computer program to generate this data on a yearly basis. Also provided a specialized lunar light calendar to HQ, U.S. Marine Corps.

Contributed to Health Hazard Assessment on the LHX with USAARL LR-86-1-3-1.

Organized meeting at USAARL for Laboratory personnel, AAH-PM, and Honeywell. The purpose was to address the fitting program associated with Integrated Helmet and Display Sighting System (IHADDS) helmet.

Provided laser safety briefings to 'C' Company, 7th Aviation Battalion.

Reviewed Night Vision Pilotage System Parametric Trade-Off Analysis study proposed submittal to NVEOC.

Background:

Refractive error--nearsightedness, farsightedness, astigmatism--is common among soldiers in today's fighting force. Armywide it is estimated that 40-50 percent of active duty soldiers require refractive correction to achieve acceptable visual acuity. The percentage is less for certain units and career fields, but even among rated aviators, it appears to be nearly 20 percent.

The standard Army means for providing refractive correction to the individual soldier is to issue spectacles. However, these devices pose two major shortcomings: they are incompatible with certain key materiel systems and they are susceptible to several adverse environmental factors. Prime examples of systems which are marginally compatible or incompatible with standard spectacles are protective masks, main weapon sights in tanks, and helmet-mounted displays which interface snugly with the crewmember's eye(s). Such compatibility problems can force costly design adjustments or nonselection of spectacle wearers to operate the system. Environmental factors which create problems for spectacle-wearing soldiers include rain, dust, aerosols, cold (lens fogging), and heat (sweat streaking). Degraded vision resulting from any of these environmental factors can reduce the soldier's capability to accomplish the mission.

As an optional means of providing refractive correction, contact lenses appear to offer several advantages over spectacles. However, contact lens wear involves risks to the ocular health of the soldier which may be intensified under field conditions encountered during training and combat. Data derived from civilian studies are not adequate to resolve questions of safety, supportability, and effectiveness of contact lens wear in operational Army environments. This is due to military-unique factors which include exposure to smokes/obscurants, extended operations in a field environment without access to normal hygiene facilities, and chemical-biological warfare operations where protective ensembles may be worn for extended periods. Thus, relevant data obtained under realistic operational conditions are needed.

The long-range goal of this research program is to establish a comprehensive database on the safety, effectiveness, and supportability of various types of contact lenses when worn in representative operational environments. The database ultimately will support the development of doctrine and policy regarding the use of contact lenses in the Army, as well as medical policy for clinical care and logistical support.

Objectives:

The major technical objectives of this program include determining success rates for fitting and wearing of contact lenses; quantifying visual and ocular effects of contact lens wear; quantifying performance effects; identifying predictors of successful contact lens wear; assessing physical changes in lenses over time; evaluating the effects of special operational conditions (e.g., smokes/obscurants, CW operations, environmental extremes, and job-specific demands); developing criteria for individual suitability for military contact lens wear; developing and validating criteria for military suitability of various contact lenses; and determining medical logistics requirements.

Progress:

All data have been collected from the Fort Hood, Texas, contact lens study. Some 326 subjects took part--215 served as contact lens wearers and 111 served as spectacle-wearing controls. TRADOC Combined Armed Test Activity (TCATA) Test Report FT 484 Controlled investigation of contact lenses and operational performances was published in June 1986. Work has begun on the USAARL report. A total of 15 pilots have been fitted with extended-wear soft contact lenses at Fort Rucker. Nine pilots are flying with soft contact lenses at Fort Hood. Arrangements have been made with optometrists at Darnall Army Hospital and the 1st Cavalry Troop Medical Clinic at Fort Hood to fit and follow approximately 20 new subjects who are expected to transition into the AH-64. An amendment to the protocol to use rigid gas permeable extended-wear lenses at Fort Rucker has been approved. The principal investigator has received Federal Food and Drug Administration investigator status for these lenses. Approximately 15 new subjects have been identified who are being fitted with this type of lens.

Products produced:

Publications:

"RK + aviation = grounded," U.S. Army Aviation Digest, 1986.

"Effects of chemical defense antidotes on aviator performance," in Proceedings of the 1986 Army Science Conference, Volume IV, 1986.

"Potential hazard for aviators flying with night vision goggles," U.S. Army Aviation Digest, 1986.

"Cholinergic effects on the visual evoked potential," in Frontiers of clinical neuroscience, Volume 3: Evoked potentials, 1986.

"The effects of cycloplegia on the visual contrast sensitivity function," Aviation, Space and Environmental Medicine (in press).

The effects of cycloplegia on the visual contrast sensitivity function. USAARL Report No. 86-2.

Concept proposal for an AN/PVS-5 simulator. USAARL Report No. 86-5.

U.S. Army aviation concept evaluation of the PLZT nuclear flashblindness protective goggles. USAARL Report No. 85-11-2-7.

Potential health hazard issues for the Light Helicopter Experimental (LHX) initial health hazard assessment. USAARL Report No. 86-1-3-1.

Light level calendars for lunar illumination at Fort Rucker, Alabama for January-June 1986. USAARL Report No. 86-2-2-1.

Light level calendars for lunar illumination at Fort Rucker, Alabama for July-December 1986. USAARL Report No. 86-8-2-3.

Visual performance with the AH-64 protective mask. USAARL report in press.

Presentations:

"U.S. Army vision standards," presented to the National Research Council, Washington, DC.

DD Form 1498 title: Auditory effects of blast overpressure

Background:

Current Army weapons development efforts aimed at countering Warsaw Pact threat capabilities include improved artillery cannons, antitank rockets, and mortars. New artillery cannons and propellant charges are being developed to meet doctrinal requirements for enhanced delivery range, rapid rates of fire, and reduced weight for air mobility. Improved antitank rockets with high-energy propellants may be fired from reflective enclosures such as bunkers or covered foxholes. And, mortar technology is being advanced to achieve greater deliver ranges and rapid rates of fire. In each of these families of weapons, dangerously high levels of blast overpressure are a byproduct of advancing weapons technology.

The high levels of blast overpressure which will be commonplace on the modern battlefield pose a potentially serious threat to the hearing of crewmembers. Hearing loss, even temporary, among soldiers using blast-producing weapons can degrade critical soldier-system performance, endanger effective command, control and communications, and disrupt critical combat tasks such as detection of the enemy during patrol missions. Hearing loss thus can endanger the soldier's capability to accomplish the combat mission. Further, permanent hearing loss is a cause of substantial disability compensation payments, even under peacetime conditions.

The existing exposure limit for impulse noise (i.e., blast overpressure) is based on a grossly inadequate biomedical database and a number of assumptions which have yet to be validated. The physical characteristics of the blast wave which are responsible for injury to the ear have not been completely identified, and the mechanisms of injury within the ear are understood only poorly. Consequently, improvements in protection technologies have been difficult to achieve.

The primary long-range goal of this research program is the development of a valid damage risk criterion. A secondary long-range goal is the development of technology, approaches, and devices for improved protection against blast-induced hearing loss.

Objectives:

The major technical objectives include quantitative analysis of the physical characteristics of blast waves, development of laboratory impulse noise exposure capabilities where pressure wave characteristics can be varied systematically, development, and validation of mathematical models to assess the efforts of protective devices on effective impulse noise exposure. Additional objectives include identification of susceptibility factors predisposing individuals to blast-induced hearing loss and development and validation of mathematical models for predicting blast-induced hearing loss.

Progress:

Development of data acquisition systems to support the study exposure limits for intense free field impulse noise continued. Numerous visits to the Los Alamos National Laboratory in New Mexico have been made to coordinate completion of measurement systems and orderly transfer to the U.S. Army Medical Research and Development Command. Kirtland Air Force Base tentatively has been identified as the site for the new contractor to execute this project.

Sensory Research Division personnel performed an analysis on a subset of the data from a study of the impulse noise attenuation of hearing protective devices which was presented at the Blast Injuries of the Ear seminar held at the Walter Reed Army Institute of Research, Washington, DC. Programming and equipment setup for data analysis is in progress.

Data collection on the noise produced by the Vulcan carrier was completed at Yakima Firing Center, Washington. Data analysis completed. Data provided as input to Health Hazard Assessment Report.

Products produced:

Presentations: "Determination of safe exposure limits for free field heavy weapon noise" at the Technical Cooperation Program (TTCP) 9-10 June 1986.

DD Form 1498 title: Noise hazards of combat vehicles program

Background:

As part of a large-scale modernization program, the Army is developing or fielding advanced design combat vehicles for a wide variety of battlefield applications. Combat doctrine being developed for the integrated battlefield calls for high-speed, lightweight, all-terrain (i.e., tracked) vehicles for fighting and transporting troops, and also for heavily armored, yet high speed tanks with enhanced firepower. Also integral to the high-intensity battlefield of the future will be high-performance helicopters with advanced design features. Such hardware combinations will generate hazardous levels of both steady noise from engines, sprockets, rotor blades, and the like, and impulse noise from machine guns, cannons, missiles, etc.

Coupled with such advanced hardware will be the requirement for continuous combat operations. This will have the effect of exposing crewmembers to greatly extended periods of steady and impulse noise in a 24-hour period. It also will likely induce fatigue and dehydration in large numbers of soldiers.

Extended exposure to hazardous levels of steady and impulse noise, especially when combined with other stressors, will present a serious risk of temporary and permanent hearing loss. Both types of hearing loss can degrade combat effectiveness by impairing effective command, control and communications, disrupting critical operator tasks, and degrading critical hearing-intensive combat activities. In addition, permanent hearing loss constitutes grounds for disability compensation.

The effective protection of soldiers from loss of hearing requires adequate hearing protection devices of all types. However, not all available hearing protective devices provide adequate protection. Rigorous evaluation of developmental and commercially available hearing protectors is required to insure adequate protection. Further, an effective hearing conservation program requires up-to-date epidemiologic data on the extent of hearing loss and the resulting impact among specific groups of Army personnel.

The primary goal of this research program is to enhance the effectiveness of hearing protection and audio communication devices in order to minimize the incidence and severity of noise-induced hearing loss among combat soldiers. Long-term goals include (1) the development of improved technologies and approaches for hearing protection and audio communications and (2) the development of improved methodology for evaluation.

Objectives:

The major technical objectives of this research program include measurement of the sound-attenuating characteristics of passive and active hearing protection devices and communication headsets, determination of the suitability of selected devices for specific Army applications, assessment of the influence of user variables on protective effectiveness, development and evaluation of new concepts for improved hearing protection and audio communications, development and validation of improved laboratory and field techniques (e.g., physical ear method) for evaluating hearing protective devices, development and validation of mathematical models for predicting suitability of hearing protective devices, assessment of attenuation effects on audiologic performance, and epidemiologic assessment of the extent of hearing loss and the associated impact among selected groups of Army personnel.

Progress:

A first draft for a physical EAR attenuation measurement standard has been completed. Minimum attenuation requirements for the SPH-4 and DH-132 helmets have been derived for both the S12.6 ANSI standard for the measurement of real ear attenuation and for the proposed physical ear standard. The specification may be used for procurement purposes to augment the real-ear attenuation testing. The method will reduce the amount of time required to perform quality assurance test and decrease procurement cost.

Data on the David Clark earmuff Type 7A was provided to Natick to determine if it is acceptable for use as an interim HCCAPS.

Measured attenuation of earcups for use with the IHADSS helmet. Measured attenuation of the following devices --(a) HCCAPS Type 5, (b) military motorcycle helmet manufactured by Scott Aviation, (c) earmuffs manufactured by Peltor, (d) David Clark earmuffs, Model E-805 for use in the direct determination of exposure limits for impulse noise and (e) measured real-ear and physical ear attenuation of SPH-4 and D-132 helmets produced by Safetech, Inc., as well as SPH-4 helmets produced by Bell Helmets, Inc.

Also measured the real-ear attenuation of DH-132 and SPH-4 in combination with E-A-R earplugs, Model 6300 earplug from 3M Corporation, Model 160 earplug from Flents, a prototype protector in combination with the PASGT helmet from Gentex Corporation, and Model 805V earmuff from David Clark Corporation.

An evaluation began on the Alpha helmet manufactured by Helmets Limited (UK). Evaluated a prototype helmet for use in combat vehicles. Completed measurement of attenuation of the HCCAPS Type 5 fitted with new earseals from Natick Laboratories. The intelligibility tests of the HCCAPS, DH-132, and improved microphone were completed. Report in progress. Attended a working group meeting for the NDI HCCAPS system at Natick. Devices from three manufacturers will be submitted for evaluation.

Developed prototype hardware and software audiometric system for use with the IBM PC. The system will be used to replace current real-ear instrumentation. The replacement system for the real ear attenuation test is completed and being evaluated.

The measurement of acoustical characteristics of Weaponeer headsets was completed. Analysis and summary of findings forwarded to PM TRADE.

The data collection on the latest version of XM-43 was completed.

Products produced:

Publications:

A comparison of speech intelligibility characteristics for earcups intended for use in the SPH-4 helmet USAARL Report No. 86-3.

A comparison between the speech intelligibility characteristics of the XM-43 and the M-24 protective masks USAARL Report No. 86-8.

DD Form 1498 title: Physiology and psychophysics of information transfer in the visual system

Background:

The development, fielding, and use of modernized Army weapons, with new doctrine for combat operations threaten to subject the modern soldier to forces and demands which exceed his biological limits. For example, new combat doctrine which places increased priority on night operations and target detection raises questions about the soldier's visual capabilities and effective procedures for maintaining and enhancing them.

The operational vision questions and problems which arise from new weaponry and doctrine require biomedical technologies and criteria for effective solutions. These technologies and criteria, in turn, demand sufficient visual function databases to support applied efforts. However, the required databases are either nonexistent or woefully inadequate. Consequently, the need for new visual function data to support solutions to contemporary and future-oriented problems is substantial. This basic research program is designed to meet this need.

Obviously, future-oriented Army problems are critical in guiding this program. However, in order to maintain a scientific base capable of addressing unforeseen problems, a proportion of the basic research is nonproblem oriented in nature. This serves at least two primary purposes. First, it adds to our knowledge of basic vision principles; and second, it keeps our scientists abreast of current findings and thinking in visual sciences such that this knowledge someday may be applied to help and protect the individual soldier.

The generic goal is to provide visual function databases and models, along with technical concepts, to support applied research and development efforts. The applications for these databases and derived models include medically valid design criteria, medical input to doctrine and tactics, and medically-

based technologies. Secondary goals of the program are to maintain professional proficiency of the scientific staff and to identify new concepts and technologies developed elsewhere with potential value for Army applications.

Objectives:

The primary objectives of this research program include developing animal models for the study of visual functions; providing quantitative models on the physiological processes and mechanisms which underlie visual perception; developing and validating concepts for new methods, techniques, and instruments to assess visual capabilities and degradations; and developing and validating new concepts for enhancing visual performance.

Progress:

A final report was published which described the effects of organophosphates and carbamates on the photoresponse of extraretinal photoreceptors of Aplysia californica. Although the two anticholinesterases had similar effects on the photoresponse, their effect on membrane resistance was different which confirms results from other studies showing different mechanisms of action for the two kinds of drugs.

The optic nerve of bushbaby, a candidate model for scotopic (night) vision, was analyzed in another published report. Only about three percent of the fibers were unmyelinated which is consistent with data from other mammals which generally have few, if any, unmyelinated fibers.

The development of a model of spatial-temporal visual capabilities is continuing. The purpose of the model is to predict visual performance in a variety of operationally relevant visual tasks (e.g., target detection and identification) and its degradation associated with military optical hardware (visors, masks, windscreens, night vision goggles), the environment (altitude, day/night conditions, haze, glare, etc.) and battlefield stressors (e.g., chemical warfare antidotes and agents).

Products produced:

Publications:

Some effects of anticholinesterase drugs and their antidotes on extraretinal photoreceptor cells of Aplysia californica.
USAARL Report No. 86-15.

The bushbaby optic nerve: Fiber count and fiber diameter spectrum. USAARL Report No. 86-4.

Operation and maintenance of the Zeiss videoplan image analysis system. USAARL Letter Report No. 86-4-2-2.

DD Form 1498 title: Military acoustic hazards: Mechanisms of hearing loss

Background:

The development, fielding, and use of modernized Army weapons, along with new doctrine for combat operations, threaten to subject the modern soldier to continuous and impulse noise levels which exceed his biological limitations. Increased noise levels and exposure profiles for a broad band range of weapons will place additional demands on the capability of the human ear to withstand high noise environments and still function adequately.

The operational noise questions and problems arise from new weaponry and doctrine require biomedical technologies and criteria for effective solutions. These technologies and criteria, in turn, demand sufficient noise effects databases to support applied efforts. However, the required databases are either nonexistent or woefully inadequate. Consequently, the need for new noise effects data to support solutions to contemporary and future-oriented problems is substantial. This basic research program is designed to meet this need.

The generic goal is to provide noise effects databases, along with technical concepts, to support allied research and development efforts. The applications for these databases include damage-risk criteria, medically valid design criteria, medical input to doctrine and tactics, and medically-based technologies. Secondary goals of the program are to maintain professional proficiency of the scientific staff and to identify new concepts and technologies developed elsewhere with potential value for Army applications.

Objectives:

The primary objectives of this research program include developing animal models for the study of auditory injury; providing a database on exposure-injury relationships for impulse and steady noise; developing and validating concepts for new methods, techniques, and instruments to assess noise parameters and hearing capabilities; developing and validating new concepts for enhanced hearing protection technology.

Progress:

Surgical procedures have been explored for electrode implant. Progress was made to develop inferior colliculus electrode implant. Several animals were implanted successfully. Minimal amounts of preliminary data were collected due to sudden death of the animals. The development of the IBM compatible PC as the data collection/experimental control system was initiated.

Data collection and analysis was completed on a study comparing anesthesia techniques in chinchilla. A report is in preparation.

One chinchilla test setup was resurrected, calibrated, and experimentation resumed after a year of down time. Experiments on the effects of the frequency of impulse energy on hearing loss was resumed. There is a strong effect of spectral content; however, there are insufficient data now to draw conclusions, re a functional relationship between intensity and frequency of impulse noise exposure.

Products produced:

Publications:

"Controlling impulse noise hazards: Programmatic model for developing validated exposure standards," in Army Science Conference Proceedings, 1986.

A chinchilla restrain system. USAARL Report No. 86-3.

The role of peak pressure in determining the auditory hazard of impulse noise. USAARL Report No. 86-7.

"The role of peak pressure in determining the auditory hazard of impulse noise," in Basic and Applied Aspects of Noise Induced Hearing Loss, (in press).

Presentation:

Effect of impulse intensity and number of impulses on hearing in the chinchilla, given at 110th Meeting of the Acoustical Society of America, November 1986.

DD Form 1498 title: Antidote and antidote/agent effects on the visual system

Background:

The chemical warfare (CW) capabilities of the Warsaw Pact pose a real threat for potential mass casualties that could at the very least compromise unit effectiveness. Serious deficiencies in the existing protective capabilities include the lack of CW agent prophylaxes, an incomplete spectrum of antidotes, and antidotes with operationally compromising side-effects. The urgent DoD requirement to develop prophylaxes, pretreatment compounds and antidotes, and the necessary concepts for their use in the medical management of CW casualties cannot be accomplished through the use of currently available information and technology.

CW agents, especially the nerve agents (organophosphates), have diverse toxic effects on both the central and peripheral nervous systems. Many of the central and peripheral effects consist of disruptions of neural functions related to the action of organophosphorus compounds on neural transmission in the cholinergic system, where acetylcholine is a known neurotransmitter. We know that acetylcholine is important in control of pupil size and accommodation as well as the processing of visual information by the retina. It also may be important at more central visual locations. However, neurotransmitters other than acetylcholine also may be involved and contribute to organophosphate-induced neurotoxicity.

In any battlefield situation, the soldier's capability to perform visual tasks is critical for completion of the mission. With widespread use of CW agents, the survival of the unit, as well as the individual, may depend on visual capabilities. Consequently, the Army's efforts to develop antidotes, pretreatments, and prophylactics require valid information on the effects of these compounds on visual functions.

The primary goal of this research is to develop a comprehensive biomedical database on the effects of selected nerve agents, candidate antidotes, possible prophylactic compounds, or combinations of the three on visual function and physiology. Ultimately, methods will be developed to predict how well a soldier will be able to visually complete his mission following a specified exposure.

Objectives:

The following technical objectives are required to achieve the program's goals:

- (1) Characterization of the effects of nerve agents and/or their antidotes or pretreatments on retinal functions.

(2) Quantification of transmission loss along the visual pathway due to drug exposure.

(3) Assessment of cholinergic system interactions with other transmitters in the visual system following drug administration.

(4) Identification of sites of action and uptake of antidotes and agents within the visual system.

(5) Assessment of visual performance loss following exposure to agents and/or antidotes.

(6) Development of models and techniques to predict impact on human visual performance and combat effectiveness.

Progress:

Visual evoked response (VER) reduction following administration of diisopropylfluorophosphate (DFP) to cats can be at least partially reversed by the administration of atropine. Without atropine, the VER recovers within 10 to 20 hours while central and peripheral acetylcholinesterase (AChE) remain inhibited. Cortical gamma-aminobutyric acid (GABA) probably compensates for excess acetylcholine (ACh). A consistent increase in the turnover of dopamine (DA) in the cortex suggests that DFP has an effect on catecholamine metabolism.

Our neurochemical results suggest an effect of DFP, or possibly cholinergic neurons, on DA, glycine, and GABA systems or neurons within the retina. Release studies on cat and rabbit eye-cup preparations suggest that DFP has a direct effect on DA and GABA retinal neurons. Although we see similar changes in the cat and rabbit VER after DFP (preferential loss to lower spatial frequency stimulation), some of the underlying neurochemical changes appear to differ.

To determine if human blood cholinesterase like cat blood cholinesterase is inhibited by halothane anesthesia, we obtained blood samples from patients undergoing elective surgery. Blood cholinesterase was inhibited in less than 20 percent of the humans (both males and females) compared to 67 percent of the cats.

Products produced:

Publication:

"Cholinergic Effects on the Visual Evoked Potential," Evoked Potential, 1986.

"Visual Recovery Following Diisopropyl Fluorophosphate,"
Toxicologist, 1986.

"Neurochemical Changes in the Cat and Rabbit Visual System
Following Organophosphate Exposure," Federal Proceedings, 1986.

Presentations:

Cholinergic Effects on the Visual Evoked Potential, given at
the 46th Winter Meeting, Eastern Association of
Electroencephalographers, Mont Orford, Quebec, Canada, 1986.

Recovery of the Visual Evoked Response Following
DFP: Involvement of Non-cholinergic Systems, given at the Annual
Meeting of the American Society for Pharmacology and Experimental
Therapeutics, Baltimore, Maryland.

DD Form 1498 title: Aviation performance effects of chemical
warfare antidotes and pretreatment therapies

Background:

Army aircrews are at serious risk if they must accomplish their mission on the chemically-contaminated battlefield since even nonlethal riot control agents such as tear gas may disrupt the ability of aviators to maintain control of their aircraft. Should aviators encounter a chemical agent, the potential outcome is the loss of aircrew and aircraft and the failure of the mission. While crews and passengers could conceivably don protective gear as needed, the inability of the pilot to turn from the flight task, and the lack of sufficient room in the cockpit to don a chemical defense ensemble, necessitate that, in any chemical threat situation, the pilot must have previously donned the ensemble. Thus, the ability of the pilot to effectively operate his aircraft while in a chemical defense ensemble is the first key to operational effectiveness on the chemically contaminated battlefield.

The second key to effective operation in a chemically contaminated environment is the development of antidotes and pretreatment compounds which, at a minimum, will allow the safe return of the crew and aircraft. The compounds which would allow efficient mission accomplishment even after chemical agent exposure have not been found. Three compounds---atropine, pralidoxime, and pyridostigmine---are under current consideration, and the ability of the Army aviator to fly his aircraft after having taken these drugs must be addressed. Each

compound has side effects which suggest a priori that effective mission accomplishment or even safe flight may not be possible after receiving a "doctrinal" dose of these drugs alone or in combination with each other. The need to determine the performance effects of antidotes and pretreatment compounds is driven by the requirement for Army aviators to survive and maintain combat effectiveness on the chemically contaminated battlefield. Systematic research using controlled, simulated flight conditions must determine the performance and physiological effects of antidote and pretreatment compounds on aviators. Then if safety permits, in-flight validation of these effects during simulated tactical missions must be accomplished.

Objectives:

To develop and exercise a simulated flight and in-flight research program that will assess the performance of Army aviators who are voluntarily administered both actual and candidate chemical warfare antidote and pretreatment drugs, either alone or in combination with each other, in varying degrees of Militarily Oriented Protective Posture and under a range of environmental conditions. This research program will determine, through objective performance measures and physiological monitoring techniques, the effects of these drugs on the flight efficiency of Army aviators while accomplishing the flight tasks required by operational scenarios.

Progress:

Data collection for Phase I of the study to determine the effects of atropine alone on the ability of Army aviators to fly a simulated mission was completed and the results have been analyzed. During this study, the effects of atropine (0 mg, 2 mg, 4 mg) on simulator flight performance, psychomotor activity, psychophysiological responses, biochemical balance, cognitive performance and physiological stressors were evaluated across 12 Army aviator volunteers. The results demonstrated statistically significant differences in performance across the dosage conditions, although these small decrements were not thought to be operationally meaningful. The results from the Phase I study were presented at the 1986 Army Science Conference as well as at numerous other professional meetings. Preparations for Phase II of this study, in which an in-flight validation of the Phase I results will be made, have been completed, approval to proceed has been granted and the first volunteer subject is scheduled for 2nd Quarter, FY 87.

Products produced:

While the preliminary results of Phase I of this study have been analyzed and presented at various briefings, final data

analysis is still on-going. This analysis is expected to result in publication of one or more USAARL technical/letter reports (currently in preparation).

A compact, battery-operated, field-portable, electronic device capable of presenting a psychological performance test battery to subjects, recording their responses and providing summary data for analysis has been produced under an SBIR contract.

Telemetric systems for psychophysiological and video monitoring of volunteer aviators while actually in-flight have been developed and are being improved while in use. Based on the need for field acceptable performance measures to accurately predict the effects of antidote and pretreatment drugs on pilot performance, a methodological approach developed from Phase I simulator research will continue to be validated during Phase II in-flight work. The major product of this program continues to be an antidote and pretreatment drug dosage profile of aviators while performing tasks similar to those they must effectively accomplish during actual flight missions. These data are of critical importance to strategists, logisticians, and tactical commanders who must plan for battles to be fought under chemical warfare conditions.

A Task Order Contract providing for contractor accomplishment of all data collection and analysis of the Performance Assessment Battery portion of future phases of this research is in place and is currently operational.

DD Form 1498 title: Research countermeasures for significant medical hazards in military systems

Background:

USAARL is tasked by Commanding General, U.S. Army Aviation Center (USAAVNC) to assist in providing support for human factors issues as they relate to rotary-wing air-to-air combat training both in the classroom and in actual flight maneuvers. Under this program, the issues of physiological stress and fatigue and their impact on crew rest guidelines are of major concern.

Objective:

Since actual training in rotary-wing air-to-air combat is a relatively new concept/requirement and is conducted under rigidly controlled and restricted conditions, access to this arena for research purposes is difficult at best. As a member of the

Air-to-Air Combat Human Factors Work Group, which includes ARI, HEL, USASC, DOTD and others, USAARL strives to gain as much data as possible during actual training phases. Attempts are made to determine how best to identify, classify, and quantify the psychological and physiological stress and fatigue issues resulting from air-to-air combat maneuvering as it is taught to and flown by U.S. Army aviators IAW FM 1-107.

Progress:

Due to restricted access to actual training conducted on-site at Fort Lewis, Washington, and at Hunter-Liggett, California, actual data collection during Phase I of this work was limited to a subjective questionnaire compiled by all members of the Air-to-Air Combat Human Factors Work Group. Data analysis from USAARL portion of this questionnaire has been completed and the results reported to the Chairman of the group. A USAARL researcher continues to monitor developments within this program and is part of planning for its second Phase.

Products produced:

Subjective questionnaire results data analyzed and reported.

DD Form 1498 title: Research countermeasures for significant medical hazards in military systems

Background:

USAARL conducts applied medical research designed to identify, assess, and prevent unnecessary health hazards and personal injury imposed by exposure to the operational environment, toxic gases, chemical and biological agents, etc., which are routinely encountered by the Army aviator and to provide technical information, recommendations, and standards to be used in the development and modification of these elements or systems as an inherent responsibility.

Objectives:

To conduct applied medical research utilizing application of physiological and biomedical research methods such as physical examinations, X-rays, biochemical analyses, cardiopulmonary function testing, and clinical medical expertise to isolate aviation hazards and determine the best protective measures when hazards cannot be totally eliminated. Critical to this effort is establishment of the biomedical requirements of environmental control and oxygen generation systems and life support survival equipment.

Progress:

Final data analysis and results interpretation of a previously completed field study designed to determine the effects on aviator performance of various levels of chemically-protective uniforms, both with and without use of external microclimate control systems, was completed and published. The results of this study have been briefed at various DoD levels. A computerized mathematical model, based on the results of this study and capable of predicting heat stress, has been developed and found to have practical application. Although not directly involved, USAARL investigators acted in a consultatory role to the Army Environmental Hygiene Agency on issues concerning toxic gas analysis of various helicopter-borne missile systems. USAARL investigators also participated in a field evaluation of sustained flight operations as part of Operation Grisly Hunter at Fort Huachuca, Arizona. A letter report is in preparation based on the data collected during this effort.

Products produced:

Publications:

Microclimate cooling and the aircrew chemical defense ensemble. USAARL Report No. 86-12.

DD Form 1498 title: Biomedical application and health hazard assessment of oxygen enrichment breathing systems

Background:

Oxygen systems for use by Army aviation aircrew for altitude missions or during aeromedical missions for patient use has historically been supplied either as a compressed gas or from a liquid source. Both of these systems, while being adequate from their oxygen delivery capabilities, introduce safety and logistical problems that make them less than ideal. The capabilities of molecular-sieve oxygen concentrating materials to deliver oxygen from ambient compressed air utilizing a small, lightweight concentrator, which can be powered by aircraft electrical systems and use turbine bleed air as a source of compressed air are being developed for general use.

Objectives:

Molecular-sieve oxygen concentrator technology has been tested and validated as being capable of producing oxygen for aircrew. It also is capable of providing an oxygen source for patient use pending acceptance by medical oxygen standardization

groups. Prior objectives under this program have included assessment of environmental hazards such as toxic or noxious chemicals or particulate matter produced by aircraft engines and potential filtration of chemical warfare agents by the materials themselves. The current objective is final work in this area and technology transfer to other agencies within the Department of Defense for exploration of the applicability of this process to larger, ground-based units.

Progress:

Separate contract efforts involving potential application of molecular sieve technology in chemical defense filtration systems and computer-modeling for optimization of oxygen generation systems were completed and final reports submitted and accepted. USAARL personnel were involved intimately in the transfer of this technology to the Fort Belvoir Research and Development Command as a part of the larger Project Nightingale. This project is intended to optimize utilization of the Turbine Engine Power Plant that is integral to certain forward-deployable, field hospital units. During the summer of 1986, an on-site demonstration of adaptation of an oxygen-concentrator for use with this turbine was successfully carried out specifically for The Surgeon General (TSG). The results of this test were briefed to TSG and are being documented in a USAARL laboratory report. An abstract of this report was accepted for oral presentation at the 58th Annual Scientific Meeting of the Aerospace Medical Association.

Products produced:

Publications:

Onsite field oxygen production using a molecular-sieve concentrator: A feasibility study in support of Project Nightingale. USAARL report (in preparation).

DD Form 1498 title: Army program for testing and evaluation of aeromedical equipment

Background:

This program utilizes existing military standards to test and evaluate all medical equipment proposed for use aboard Army aircraft. Significant hazards to both aircraft and patients exist from equipment that does not meet these standards due to either interference by medical equipment with aircraft operation or by the aircraft systems' interference with medical equipment function.

Objectives:

Both developmental and nondevelopmental medical equipment destined for use aboard Army aircraft will be tested under this program. Assessment of developmental equipment as a complement to work ongoing at USAARL will occur as early in the design phase as possible to maximize cost-effectiveness of solutions to identified incompatibilities. Equipment will be tested for electromagnetic interference, environmental extremes, altitude effects, vibration effects, and general electrical safety. In-flight evaluation will be conducted as appropriate, and a human factors evaluation will be conducted on all equipment. An annual report of approved and disapproved nondevelopmental medical equipment, compiled from the individual test reports, will be published for Department of Defense distribution.

Progress:

USAARL personnel completed the installation of a shielded enclosure for testing of equipment to MIL-STD-461B, the development of specifications, procurement and installation of an environmental chamber, an altitude chamber and a vibration table to perform testing of equipment to MIL-STD-462. Progress continues on structural alterations to the work space. Additional personnel requirements for the program were recognized and demonstration testing of aeromedical items was initiated. A Memorandum of Understanding (MOU) was initiated with the Academy of Health Sciences and other agencies involved in the test and evaluation of aeromedical equipment. Presentations were made on this program at the Army Operational Aeromedical Problems Course and at the Medical Research and Development Command Commanders' Conference.

Products produced:

Publications:

Determination of space requirements for medical tasks on MEDEVAC aircraft. USAARL Report No. LR-86-7-3-3.

Determination of minimum litter capacity for the utility version of the light helicopter experimental (LHX) aircraft system. USAARL report in preparation.

Army program for test and evaluation of aeromedical equipment. USAARL report in preparation.

DD Form 1498 title: Aeromedical research of operationally significant problems in the Army aviation environment

Background:

Military records and reports from several nations indicate that aircrews vary widely in measures of military effectiveness. One of the recommendations of a major study of military pilot effectiveness was the desirability of being able to measure and assess the ability to withstand psychological stress with a small apparatus or simple test. The Laboratory investigates the utility of such devices, such as the Zero Input Tracking Apparatus (ZITA), as candidates for such use. Information on resistance to stress has potential utility in pilot selection, assignment to stressful and high-workload duties (such as piloting the AH-64), and medical evaluation of fitness for military flight duties.

Objectives:

The objective of this project is to provide a definitive assessment of medical problems peculiar to the aviation environment and to prepare guidelines for field commanders on the impact of these problems on the aviation mission. The results of such research will aid in development of improved standards and biomedical techniques for the field flight surgeon to use in monitoring and treating aviator stress and fatigue as well as medical standards for selection of aviators and air traffic controllers for specific assignments.

Progress:

A 12-man multidisciplinary research team has been organized to provide a team approach to problem solving. Expertise from these team members already has provided sustained review, definition, and potential solutions within the Army's Advanced Rotorcraft Technology Integration (ARTI) single pilot workload assessment, the UH-60 stabilator accident issue, and stress/workload issues for air-to-air combat techniques and tactics. Additional research was completed at the request of the Army Aviation Center addressing potential stress issues associated with instructor pilot assignments and duties. Through contract efforts, potential research systems are being evaluated for their utility in assisting team efforts for evaluating stress and workload within the operational military environment.

Products produced:

Results of the research into stress issues associated with instructor pilot duties and assignment have been presented and briefed to appropriate individuals. Publication of the results of this study is pending.

DD Form 1498 title: Artificial intelligence and robotics:
Biomedical applications.

Background:

This project directly addresses the Laboratory's mission to develop improved means of patient evacuation and devise improved design of life support equipment. The project indirectly addresses the Laboratory's mission to develop countermeasures for stress, fatigue, and health hazards by providing a technical database for improved techniques and design of man-machine interfaces. This research also benefits the Laboratory's consultation and health hazard assessment assignments for the Army's LHX program. The nature of the modern battlefield and anticipated lack of numerical superiority will prevent timely or efficient evacuation of casualties. Mass casualty situations, potential chemical and/or radiological contamination, and medical personnel shortages will endanger medical mission accomplishment.

Objectives:

Automated medical treatment and diagnostic aids will enhance medical capabilities and help reduce the workload of medical personnel. Improved means of medical diagnosis and treatment will aid the implementation of the "far-forward care" and "continuum of care" concepts of the medical mission. The primary objectives of this project are to develop medically oriented expert systems; to evaluate artificial intelligence and applications for enhancing human safety; and to investigate artificial intelligence techniques for reducing human workload in advanced avionics crew stations, thereby impacting crew selection, man-machine compatibility and automated aviation crew station design.

Progress:

A laboratory report outlining preliminary design considerations for a combat emergency medicine expert system (CEMES) was completed and published. Phase I of CEMES exploratory development (closed-loop diagnosis and treatment of shock under ideal conditions) was completed. Preparation of laboratory reports documenting CEMES Phase I was initiated concurrently with the beginning of Phase II CEMES (expansion of CEMES for chemical contamination and degraded mode operation). The principal investigator completed a training course in LISP and the use of the Symbolics LISP machine.

Products produced:

Publications:

Concept study of closed-Loop medical expert systems. USAARL Report No. 86-6.

DD Form 1498 title: Physiological and psychological effects of extended operations and NBC environments on combat vehicle crews (P2NBC2)

Background:

As a direct result of the expertise acquired by USAARL in the techniques of medical safety monitoring and research data collection during on-site field research with human volunteers under simulated tactical conditions, the laboratory was tasked by Commanding General, U.S. Army Medical Research and Development Command (USAMRDC) to support an effort initiated at Fort Knox, Kentucky, by the U.S. Armor and Engineering Board. This project was mandated by a Vice Chief of the Army staff directive to produce a "how-to-fight in an NBC environment" manual for use by field commanders. USAARL's involvement escalated from the initial small trial at Fort Knox, through field tests at Aberdeen Proving Ground, Maryland, a second, larger armor test at Fort Knox, field artillery tests at Fort Sill, Oklahoma, and finally a large-scale, 8-week, on-site test with the crews of four Bradley Infantry Fighting Vehicles at Fort Benning, Georgia.

Objectives:

The initial mission and objective given to USAARL was to provide medical safety monitoring for volunteer crewmembers who would be performing sustained military operations while wearing military-oriented protective posture clothing in hot weather. In addition to monitoring of physiological parameters such as heart rate and core temperature, an audiovisual set-up that would allow real time monitoring of the crews inside their vehicles was thought necessary. These requirements were met by USAARL investigators/technicians using state-of-the-art sensing/recording and telemetry systems. The data resulting from the medical safety monitoring, as well as any additional data derived from ancillary devices, was collected and recorded into a master database to be analyzed and interpreted for research purposes.

Progress:

USAARL assumed the lead for physiological performance (research and safety) to include fielding of mobile instru-

mentation and data recording systems for physiological and environmental parameters, data collection and database development for physiological and environmental factors, and performance of data analysis as required for the tests that occurred at Fort Knox, Aberdeen Proving Ground, Fort Sill, and Fort Benning during FY 85. Reports were completed on each of these tests and papers presented or briefings provided on the operational results at Physiological Factors Effecting Soldier Performance Symposium, USARIEM; Joint Working Group Meeting on P2NBC2, U.S. Army Armor and Engineering Board; and P2NBC2 Mission Area Analysis Technical Advisory Group briefing for the Commander, Combined Arms Center. In addition, task orders for contracting have been developed for continued improvements in the P2NBC2 arena to include the development of a new sensor technology for core temperature measurement and the development of a portable, self-contained, individualized physiological data recording system. This system will have some artificial intelligence capability for monitoring incoming physiological data, comparing these data to preestablished thresholds, and providing alarms if the data exceeds these thresholds. A creative report on a new predictive concept for sustained operations in differing environments was written and published and should help shape training, doctrine, and field commander planning for sustained operations.

Products produced:

Publication:

Integrated concept for physiology, psychology and performance. USAARL Report No. 86-3-3-2.

DD Form 1490 title: Aviation epidemiology data register

Background:

This project establishes an ongoing data repository of medical, physiological and some flight experience data for each Army aviator with annual update. Access to this type of information has not been previously available short of consulting the actual current medical health record of an individual aviator.

Objectives:

Summary medical data retrieval for the Army aviation force has not previously been possible. The availability created here allows data to be accessed, summarized and used in operational, research, and design applications in multiple areas of Army motion. This project will define the physiological capabilities,

variabilities, and limitations of the Army aviator population. The data will be used to formulate aircrew medical standards, help determine "best fit" placement of aviators into the most appropriate airframe/weapons system, and serve as a database for future research involving use of pharmaceuticals in aviation personnel. Selection and retention, equipment development, manpower and readiness analyses, and safety and training relationships to medical issues are other examples of potential impact.

Progress:

An automated database system for all Army aviator medical, health, and anthropometric information has been created to provide an accurate source of epidemiologic data for aviation medical selection, retention and waiver standards; efficient record access; and health tracking for medical users. Approximately 60,000 medical records have been entered into the data register. The anthropometric data were used to create a report which will result in an update of MIL-STD-1472. Briefings on this program were given at the Medical Research and Development Command Commanders' Conference and to the DoD Human Factors Engineering Technical Advisory Group. There is no longer a backlog of flight physicals to be input due to an increase in personnel and a remote input station now allows direct data input to the base as it is gathered in the anthropometric measuring station.

Products produced:

The primary product of this effort is and will continue to be the database itself. With over 60,000 records currently input and growing daily, the database becomes more and more reliable with each additional data point and already has been used in preparation of several papers in preparation for presentation at national and international meetings.

DD Form 1498 title: Biodynamics of life support equipment and personnel armor

Background:

(1). Integrated Helmet and Display Sighting System (IHADSS): The proper fitting of the IHADSS to allow for the precise positioning of the helmet display unit (HDU) is critical for AH-64 Apache mission accomplishment. Therefore, it is necessary to develop a practical knowledge of IHADSS fitting techniques to support the AH-64 in a field environment. There have been numerous occurrences of IHADSS fit problems and an inability to fully use the HDU. Many of these problems are a

result of head and facial anthropometric dimensions not being compatible with the IHADSS inner shell design. There exists a need to develop strategies to overcome these problems.

(2). Thermoplastic liner (TPL): Approximately 10 percent of U.S. Army aviators have helmet fitting problems using the current suspension-retention system in the SPH-4. This results in pilot discomfort, fatigue, and possibly inattention to flying. Most of these individuals either continue to fly with the problem, or they have it corrected locally, often having modifications made in the field that have the potential to compromise the injury prevention features of the helmet. There currently is no standard method in the U.S. Army for evaluating and correcting flight helmet fitting problems. The introduction of night vision imaging devices due to their weight and shift in the helmet's center-of-gravity (CG), has increased greatly the incidence and severity of "hot spots" experienced by the aviator population. The thermoplastic liner was developed as a potential replacement for the current sling and headband retention system. It allows a preformed fit or a custom fit to an individual head. The TPL system is simple, reusable, and affords great impact protection with increased comfort.

(3). Aircrew survival armor recovery vest, insert, and packets (SARVIP): A serious problem exists in the attempted rescue of aviators forced down in combat areas where helicopters or designated rescue aircraft are not able to land for pickup. If rescue aircraft are not equipped with standard medical evacuation rescue hoist systems, there is no safe way to extract downed pilots, especially if they are injured. Various field expedient methods such as a lasso under the armpits, a Swiss-made seat from climbing rope, and simply holding onto a line have been used with limited varying degrees of success.

The hoist pickup attachment in the SARVIP is an attempt to provide an effective alternative to the previously mentioned expedient methods. The hoist pickup would be available to all combat pilots as an integral part of their daily flight uniform/survival equipment. There is a vocalized need for this device within Army aviation and it is considered a high priority item by the user community.

(4). HGU-56 development: Since the design and fielding of the SPH-4 over 14 years ago, advances in technology have allowed the use of modern materials and methods to increase helmet performance and survivability. The threat of modern nuclear, chemical, directed energy, and electronic warfare requires an updated technological response in helmet design and performance.

(5). Aviation Life Support Equipment Retrieval Program (ALSERP): There is a need for postmishap evaluation of safety

and life support equipment performance so as to verify the requirements of military standards and recommend changes in standards to improve performance.

Obectives:

1. IHADDS: To properly fit the IHADDS helmet and develop a standardized method of fitting for the U.S. Army.

To modify helmets as necessary in order to provide a comfortable and reproducible fit while ensuring optimum protection of the aviator and maximal interaction between pilot and the aircraft.

To document and analyze the anthropometric measurements of head length, width, circumference, and bitragion-coronal arch.

To identify problems that may cause incompatibility in fit resulting in the potential for injury to the aviator and/or compromising mission effectiveness or completion.

To prepare a report on a safe approach to IHADSS fitting problems.

2. TPL: To determine whether or not the TPL is compatible with the U.S. Army's needs and mission.

To evaluate the TPL as a possible replacement for the current retention system.

To fit TPLs in SPH-4 helmets used by U.S. Army aviators and evaluate its performance when worn by operational pilots.

To evaluate the product's ability to effectively accommodate the "problem fit" crewmember.

3. Custom fitting of the SPH-4: To analyze the helmets of those Army aviators who are experiencing "hot spots" and to modify them in order to eliminate the problems.

To analyze the surface dimensions and features of aviators' heads to determine if there are any anthropometric or topographic causes for the "hot spots."

4. SARVIP: A proposed SARVIP which contains a hoist pickup attachment harness is under investigation as a replacement for the current aviator survival vest. The U.S. Army Aviation Development Test Activity (ADTA) and the Directorate of Combat Developments (DCD) at Fort Rucker, Alabama, have requested a

medical evaluation of the harness as an emergency extraction device with special attention to the physiologic and traumatic implications of the two proposed configurations of lower torso retention straps.

5. HGU-56: To coordinate specific aircraft compatibility flight testing of prototype designs and analyze the performance of HGU-56 helmets used by U.S. Army aviators during development.

To assess the compatibility of the NBC ensemble with the mission profile per aircraft type.

To verify the safety features required under military specifications (i.e., foam liner, visor, suspension systems, and crushable earcup).

6. ALSERP: To collect all available safety and life support equipment involved in causing, preventing, or not preventing injuries or deaths in aircrew and passengers from U.S. Army aviation accidents, and analyzing the performance of that equipment. In addition, the project has the mandate to analyze safety and life support equipment from accidents involving U.S. Navy and U.S. Air Force personnel.

Progress:

1. IHADSS: USAARL has continued to assume total responsibility for fitting the IHADSS for AH-64 transition training. We have trained and qualified additional fitters and currently, over 95 percent of all IHADSS fitting has or is taking place at USAARL.

USAARL, in conjunction with the PMAAH, the contractors, and Army supply facilities, has continued to monitor the standards and quality of work on the IHADSS. The inability to adequately fit certain AH-64 candidates with the IHADSS prompted MILPERCEN to request an Armywide screening of AH-1 pilots for preselection assessment of compatibility with the IHADSS. This screening began in November 1985 and was completed in April 1986. A head dimension anthropometric measurement recording study of all active Army aviators was begun in June 1986 as part of the Army Epidemiology Data Register (AEDR). This data collection is expected to be completed in June 1987 and the resulting data will be used for future helmet design and development.

2. TPL: The TPL has gone through seven major revisions since initial input by USAARL. The latest of these revisions was full styrofoam liner designed by USAARL to increase area protection. This design was provided to the contractor and has been incorporated into all new production of TPLs. In addition,

the TPL continues to be used in special fit situations where the antropometric dimensions and/or topography of the crewmember's head preclude a safe and comfortable fit with the standard suspension system.

3. SPH-4 custom fitting: The incidence of helmet fitting problems has continued to increase in FY 86 due to increased usage of night vision goggles (NVG) with the difficulties that an offset center-of-gravity and increased weight place upon the system.

The female aviation population continues to increase, making small head fitting problems even more common. This trend is one of the factors that has resulted in a new head anthropometric data collection program being started in the aviation population to aid in future helmet development.

The TPL has proven to be the most effective method of providing custom fitting for personnel with fit problems. The TPL often has proven to be the only satisfactory method of fitting females with small heads, and still provide adequate impact and noise protection.

4. SARVIP: The medical evaluation has been conducted as requested by ADTA and DCD. Major concerns included vascular and neurological conditions of each subject during suspension. Blood flow constriction, capillary filling, deep tendon reflexes, light touch tests, and walking on toes and heels before and after suspension were areas checked during testing and were found to not be compromised.

5. HGU-56: The HGU-56 currently is on hold awaiting light helicopter experimental (LHX) developments.

6. ALSERP: The ALSERP has provided analysis to the U.S. Army Safety Center and U.S. Navy in a timely manner upon request. No U.S. Air Force requests were received during FY 86.

Products produced:

IHADSS: Anthropometric head dimensions for the extra large IHADSS and XM-43 CBR mask combination were determined and are being incorporated into the extra large IHADSS design.

Anthropometric head dimensions for the AH-64 candidate selection were determined and currently are in use worldwide until the extra large IHADSS becomes available.

TPL: USAARL is the vanguard of support of TPL technology for helmet fit and has presented the TPL for Army acceptance.

SPH-4 custom fitting: The database is being assessed for future input to the military specifications for anthropometric considerations.

ALSERP: FY 86 has been limited to accident investigation and/or assistance.

DD Form 1498 title: Anthropometric criteria for Army aviators

Background:

With the emphasis upon incorporating females into the U.S. Army, there came the increasing realization that empirically-based criteria to guide the selection of personnel did not exist. For those seeking entrance into the Army aviation program, the criteria traditionally had been based on the 5th-95th percentile male. To rectify this circumstance, the Laboratory embarked upon a major research effort to develop empirically-based selection standards to assure that an effective aviator-cockpit compatibility exists for each of the aircraft in the present Army inventory.

The program consists of five separate subtopics: (a) a physical determination of aircraft cockpit reach-related requirements; (b) a determination of actual, cockpit-referenced eye positions of rated Army aviators for the Army's principal rotary-wing aircraft; (c) a determination of the in-flight control force requirements which exist during "hydraulics-off" emergency landing maneuvers; (d) a determination of helicopter control-related physical forces exertion capabilities; and (e) an evaluation of the effects of variation in the level of control force resistance upon performance as a function of subject strength.

Objectives:

The increased concern about the use of women in the Army has resulted in the need to reevaluate the anthropometric criteria cited in AR 40-501 concerning Class 1, 1A, and 2 flying duty. Cockpit design criteria employ 5th-95th percentile male dimensions as referents. Medical standards cited in AR 40-501 are not consistent with these guidelines. Hence, a need exists to reevaluate and modify, as appropriate, extant anthropometric criteria.

Products produced:

Publications:

Seated eye positions and anthropometric extremes of Army aviators. USAARL Report No. 86-9.

In-flight control force inputs for the U.S. Army UH-1 helicopter during "hydraulics-on" and "hydraulics-off" approaches and landings. USAARL Report No. 86-10.

Proportions of overall U.S. Army male and female population eligible for flying duty. USAARL Report No. 86-14.

DD Form 1498 title: Vibration hazards of combat aircraft and vehicles.

Background:

Research conducted under this work unit provides insight into the whole-body vibration (WBV) health-related issues of Army tactical/combat vehicles, aircraft, and selected weapons systems. This is accomplished by:

1. Conducting multidisciplinary and applied biomedical engineering research to determine short-term and cumulative biomedical effects on WBV on the operators and crews of military vehicles, and developing methods to reduce these effects.
2. Duplicating field WBV environments to study the effects on soldier health and performance.
3. Providing a scientific database of militarily relevant and medically pertinent information on WBV effects.
4. Evaluating and developing medical criteria on human WBV tolerance and providing collateral support to human tolerance studies and materiel development.
5. Minimizing fatigue and maximizing physiological efficiency and endurance in the combat environment.

Objectives:

The standard currently used for evaluating health hazards associated with whole-body vibration is International Organization for Standardization ISO 2631, Guide for the evaluation of human exposure to whole-body vibration. The empirical basis for this standard is inadequate as indicated during the operational testing of ground vehicles, including the Fast Attack Vehicle (FAV). As a result of these recognized

shortcomings, USAARL has been tasked by the Office of The Surgeon General and Headquarters, U.S. Army Medical Research and Development Command, to conduct research resulting in viable WBV standards that are pertinent to the operational military environment.

There is no evidence in the domain of helmet design to show how helmet design influences vibration characteristics of the head-neck-helmet system head-tracking performance. Current trends are to use the pilot's helmet as a mounting platform for advanced technological devices. This alters both helmet weight and center-of-gravity. The question being asked is how do these changes effect neck muscle fatigue and hence alter a pilot's head-tracking ability while in the vibration environment.

Among the specific objectives are to conduct field WBV measurements on currently fielded tactical/combat vehicles and aircraft and compare these data against current ISO standards. Final outcome will be recommendations for a more realistic WBV standard for use when conducting human hazard assessments in support of AR 40-10.

Other objectives are:

To assess the effects of vibration on muscular fatigue.

To build a tape library of vibration data for use in whole-body vibration research. The tapes will be used as input for the multi-axis vibration simulator or for the single-axis vibration simulator. The goal will be to have representative vibration spectra for a wide variety of Army vehicles and aircraft with particular emphasis on combat aircraft and tracked vehicles.

To determine which helmet design parameters (weight, center-of-gravity) have the greatest effect on a pilot's head-tracking performance in the vibration environment.

To determine which axis of vibration has the greatest detrimental affect on head-tracking performance (x-, y-, z-axis or a combination of all three).

To determine the effects of fatigue on neck muscle electromyography (EMG).

To determine objective criteria for neck muscle fatigue using EMG and muscle force response.

And to apply neck muscle fatigue data to a model of the head and neck for use in determining head-tracking performance decrement with helmet loading.

Progress:

A battery-operated portable instrumentation package for recording whole-body vibration was designed, constructed, and field tested. Whole-body vibration signatures from the Counterobstacle Vehicle were obtained for the vibration database.

A whole-body vibration health hazard assessment was performed for the Counterobstacle Vehicle.

A Request for Proposal addressing the development of militarily relevant vibration exposure standards was completed, released for bids, and a site visit was held to clarify issues raised by the prospective contractors.

A protocol was written and research efforts began comparing segmental vibration levels in the hands of UH-1 helicopter pilots to those suggested in American National Standards Institute report S34.198X. Six subjects were run in laboratory and field trials with the electromyographic data and grip force data being compared. Vibration data was collected in the field and is being analyzed.

An effort to describe terrain surface roughness was initiated in support of the vibration health hazard assessment program. Field data was sampled and processed to develop a measure of surface roughness. Further efforts to develop digital filters to improve the measure are being investigated.

Products produced:

1. A portable battery-operated whole-body vibration recording system was completed and field tested.
2. A Request for Proposal was completed and bids were received toward the development of militarily relevant whole-body vibration exposure standards.
3. A whole-body vibration health hazard assessment report was completed for the Counterobstacle Vehicle.
4. Data was collected towards the determination of segmental vibration levels in the hands of UH-1 helicopter pilots

Publications:

A comparative analysis of whole-body vibration exposure at the gunner position of the Vulcan Wheeled Carrier and the towed Vulcan air defense system. USAARL Report No. LR-86-6-4-2.

DD Form 1498 title: Impact biomechanics, trauma, and tolerance criteria

Background:

Impact is a short and violent mechanical insult, characterized by forces of short duration and high magnitudes. Impact to the human body may occur as the result of aircraft crashes, ground vehicle accidents, pyrotechnical explosions, falls, parachute jumps, and other interactions between the soldier and his environment during training or battle missions. When direct impact is cushioned by soft tissues of the body, such as blows to the abdomen, or when the striking surface deforms under impact, forces of longer duration are generated.

Impact trauma of the human body occurs by deformation tissues beyond their failure limits, resulting in damage to anatomical structures and, more importantly, to disablement of their functions. Nonpenetration injuries, such as bone fractures or contusions to internal organs, may be caused by direct blows of blunt objects or simply by violent motions inside the body. This type of injury generally is more difficult to identify, understand, and manage as contrasted to penetrating injuries. Principles of physics are applied in the study of biomechanics of impact and physiologic dysfunction, and to determine the limits of tolerance and impact. A sound understanding of the injury process forms a sound basis for the development of valid assessment procedures, models, criteria, and standards which are used to evaluate existing and emerging life support equipment (LSE), and to design and improve other man-machine interfaces.

The U.S. Army Mission Area Analysis identifies research and development in LSE (i.e., helmets, vests) as important tasks. This cannot be accomplished effectively without accurate biomechanical data on the response and tolerance of various body parts. Responding to the urgent request for health hazard assessments of Army equipment is delayed when needed, but nonexistent biomechanical data first must be generated. Therefore, it is necessary to identify and priority-rank the human body areas where sufficient and accurate biomechanical data do not exist. The analysis of the accident investigation database is an excellent first step in this process.

Objectives:

To conduct basic and applied research on the biodynamics of impact, and to determine human impact tolerance levels in order to provide biomedical and design criteria for the development and improvement of military helmets and other life support equipment for the soldier.

Assess the health hazard potentials of specific life support equipment, through engineering analyses, laboratory and field testing, and mathematical simulations.

Conduct basic and applied research to generate biomechanical data on human physical and physiologic response to impact, to determine the thresholds of human impact tolerance limits, and to establish injury criteria.

Establish design specifications, test procedures, and standards to evaluate with respect to the ability to defeat cardio-thoracic trauma to the chest using porcine subjects. Preliminary results indicate that that the 3/4-inch standoff distance produces trauma beyond human tolerance and that by increasing the distance to 1 1/4-inch, the trauma is minimized.

Products produced:

A Request for Proposal titled Head impact force acceleration measurement system was written and staffed.

Presentations:

Vibration in the aviation environment given to the U.S. Army Flight Surgeons' Course, Fort Rucker, Alabama, March 1986.

Whole-body vibration given at the U.S. Army Medical Research and Development Command Commander's Conference, Fort Rucker, Alabama, January 1986.

DD Form 1498 title: Life support equipment crashworthiness evaluations

Background:

The crashworthy performance of existing aviation life support equipment (ALSE) needs to be known prior to updating crashworthy design criteria. Once the hazards are identified, methods to eliminate them can be developed.

Objectives:

To identify impact injury mechanisms of Army fliers, parachutists, and ground vehicle occupants, and to provide impact design criteria for new and existing life support equipment (LSE) for these personnel.

Progress:

1. During FY 86, the Army's new prototype motorcycle helmet was tested for impact against 1975 Snell Foundation standards and approved for field testing.

2. The analysis of the UH-60 seat impact data was completed and a report was published by the University of Michigan. The data collected was used to help rewrite MIL-STD-58095 and MIL-STD-1290.

3. Work continued on a "standard" aviator DoD handbook.

4. The tests to determine the effect of defeating a .50-caliber impact into chest armor was completed; this project is transferred to a new 1498 for FY 87.

5. Developmental tests were conducted on SPH-4 flight helmets and tankers' helmets.

6. The high speed, low level parachute development was monitored and human tolerance relative to jump position at parachute opening provided.

Products produced:

Publications:

Improved design criteria for crash helmets. USAARL Report No. 86-11.

A device to locate the center-of-mass of a helmet. USAARL Report No. LR-86-5-4-1.

Potential health hazard issues for the light helicopter experimental (LHX): Initial health hazard assessment. USAARL Report No. LR-86-1-3-1.

Presentations:

UH-60 crew seat comparative impact testing given to the American Helicopter Society National Specialist's Meeting, Atlanta, Georgia, April 1986.

Air Standardization Coordination Committee
(ASCC), Working Party 61

The Air Standardization Coordinating Committee (ASCC) Working Party 61, is a chartered international military organization of English-speaking nations which addresses aerospace medicine and life support. Emphasis is placed upon standardization, interoperability, and technology exchange. Member nations include the United States, Canada, the United Kingdom, Australia, and New Zealand. USAARL provides technical consultants and a principal committee representative to actively participate in the committee's activities, and to coordinate Army Medical Department (AMEDD) participation. Dr. John Crosley represents the Laboratory and Army aviation medicine to this group.

The ASCC is chartered to negotiate test participation agreements among the five English-speaking member nations and military services. These agreements provide for the evaluation, test, or review of a specific piece of equipment by another country or service not normally having access to that equipment. The evaluation data may be jointly gathered but, in any event, is shared between countries and published as a formal report in accordance with the terms of the agreement.

NAS-NRC Committee on Vision and Hearing,
Bioacoustics, and Biomechanics (CHABA)

USAARL has been an active participant in the science and technology exchange programs of the National Research Council (NRC) since the mid-1960s. USAARL scientists participate as working members to the various ad hoc and working groups of the CHABA and Vision Committees. The Army representative to the CHABA and the Committee on Vision (COVIS) is USAARL scientist LTC Bruce Leibrecht. Dr. James H. Patterson, Jr., Dr. Isaac Behar, Dr. John Crosley, and Mr. Ben Mozo also participate actively.

DoD Human Factors Engineering Technical Advisory Group

The Human Factors Engineering Technical Advisory Group (HFE-TAG) was established to perform the following functions:

1. Provide a mechanism for exchange of technical information in the development and application of human factors engineering technology.
2. Enhance working-level coordination among government agencies involved in HFE technology research, development, and application.
3. Identify human factors engineering technical issues and technology gaps.
4. Encourage and sponsor in-depth technical interaction including subgroups as required in selected topical areas.
5. Assist as required in the preparation and coordination of tri-service documents such as technology coordinating papers and topical reviews.

USAARL representatives to the HFE-TAG are COL J. D. LaMothe, Dr. M. Sanders, and Mr. R. Simmons.

NATO Defense Research Panel, Research Group 6, Effects of Impulse Noise

Formed into a group in 1978, Canada, France, Germany, the Netherlands, Norway, the United Kingdom, and the United States collect and evaluate data on permanent threshold shifts induced by weapons firing in military practice from both light and heavy weapons in relation to the noise exposure. The group evaluates methods of measurement of impulse noise and compares different impulse noise damage-risk criteria used by the participating nations. It evaluates the effects of noise-induced hearing loss on performance, collects and evaluates data on nonauditory effects, and exchanges information on the applicability of hearing protectors on the effects of hearing protection in military practice.

Dr. James H. Patterson, Jr., was appointed to membership in this working group in 1980.

Human Factors in Aviation Screening and Performance Prediction SubTAG of the Human Factors Engineering Technical Advisory Group

The scope of activities of this Department of Defense group include the exchange of information, the working level coordination, and the identification of requirements for all technical areas which are applicable to selection and prediction for purposes of improved manpower utilization in aviation systems. By screening is meant those processes involved in the development, quantitative validation, establishment of performance-based standards, implementation, and management of instruments to be used for identifying applicants for aviation training and transition programs. By prediction is meant those processes involved in the quantitative estimation of probabilities of successful performance and individual differences in performance of specified missions/functions in training and operational environments of the aviation community. These processes include the development, implementation, and management of prediction systems applicable to classification, track/pipeline qualification, progression through training, and operational mission responsibilities. Dr. Sanders served as chairman of this group in 1985.

LHX Senior Advisory Group

The LHX Senior Advisory Group (SAG) is composed of senior level Army personnel who meet periodically to review progress on the development of the LHX and provide guidance and direction for future work. USAARL representatives are COL D. R. Price, COL J. D. LaMothe, and Dr. M. Sanders.

American National Standards Institute (ANSI) Committees S1, S3, and S12

These committees operate under the Acoustical Society of America by agreement with ANSI. They manage the development of a variety of national acoustical standards and coordinate international standardization in these areas. In 1983, USAARL became a member of these three committees. USAARL representatives are Dr. James H. Patterson, Jr. and Mr. Ben Mozo.

Emergency Mobilization Board National Disaster Medical System (NDMS)

NDMS serves as coordinator of federal level disaster relief and assistance for very large scale CONUS disasters. It coordinates planning for medical assistance on site, but also contracts with hospitals to provide up to 100,000 inpatient beds around the country for field-stabilized victims. This program has integrated the original Civilian Military Contingency Hospital System (CHCMS) into its operation so that OCONUS military casualties returned to CONUS after initial stabilization also can be hospitalized on a regional basis. MAJ Glenn Mitchell serves as one of the two Army representatives on the medical advisory panel for that system and was presented a recognition award by the Public Health Service in 1985 for his service on that panel over the past several years.

Physiological and Psychological Effects of NBC Sustained Operations on Combat Vehicle Crews (P2NBC2) Test Scientific Advisory Group (TSAG)

The TSAG is comprised of representatives from the Army scientific community and the operational community involved in this multiyear study of small unit and individual level effects of current NBC hardware, tactics, and doctrine in each of the combat arms. Potential fixes to identified problems are proposed, implemented, and tested during field and laboratory studies with operational level guidance as the end product goal. The TSAG reports to the joint working group at the Fort Knox U.S. Army Armor and Engineer Board Center of Excellence with its evaluations of research protocols for various test boards and scientific data analysis of completed tests. Drs. Michael Sanders and Francis Knox, III, and MAJ Glenn Mitchell currently serve on this advisory group.

Tri-Service Aeromedical Research Panel

The Tri-Service Aeromedical Research Panel (TARP) was established in 1976 for the purpose of fostering technical exchange, reviewing ongoing joint research programs, making recommendations for future joint research programs, conducting cooperative reviews of individual programs to avoid duplication, and submitting a recommended course of action to The Surgeons General of their respective services. The panel has proven to be an effective administrative entity in the DoD research community.

The TARP consists of 12 members which include two laboratory representatives from each service; a Surgeon General's representative from each service; one representative of the U.S. Army Medical Research and Development Command; one representative of the Naval Medical Research and Development Command; and one representative of the Headquarters, Air Force Aerospace Medical Division, or Headquarters, Air Force Systems Command. The TARP meets in business session twice a year and hosts one extensive technical meeting.

COL Dudley R. Price serves as the Army senior service representative and as chairman at TARP, and COL J. D. LaMothe represents the Laboratory's interests.

The TARP has the authority to charter technical working groups (TWG) for the purpose of interacting at the scientific bench level and working on viable interservice cooperative research programs. At present, only one TWG exists - the one for Biodynamics: The human effects of vibration, impact, and acceleration. Under the auspices of this TWG, a joint service, Department of Transportation study to develop a standardized set of algorithms that describe the 50th percentile male aviator has been accomplished and a draft report was circulated to the TWG members. In addition, six individual laboratories from the three services jointly funded a research contract with the Anthropology Research Group (ARP), Yellow Springs, Ohio, to develop a standard for the small and large aviator. ARP is analyzing the available data from the 1967 Air Force aviator anthropology study to provide a draft report to the TWG by first quarter, FY 87, on the small and large aviator.

Mr. Joseph L. Haley, Jr., CPT Roy Maday, and CPT Barclay Butler are the Laboratory representatives for the TWG.

Army Life Support Equipment Steering Council

This advisory council was chartered in the mid-1970s by the Commanding Generals of the U.S. Army Aviation Systems Command (AAVSCOM) and U.S. Army Training and Doctrine Command (TRADOC), the Office of The Army Surgeon General, and U.S. Army Forces Command (FORSCOM). This is a review and advisory council that ensures timely and pertinent technical exchange of information regarding the development, logistics, use, and field problems associated with aviation life support equipment (ALSE). The committee meetings held yearly have proved to be an effective vehicle for maintaining a coordinated flow of technical information regarding life support equipment problems. USAARL participates as the principal technical consultant to the council and is instrumental in formulating AMEDD positions and policies.

The advisory council met at USAARL in 1985. USAARL will be nominated as a voting member of the council at the next meeting.

The issue of the establishment of an Army life support equipment specialty is still pending DA approval. The ALSE school established at Fort Eustis, Virginia, currently is writing a set of ALSE manuals incorporating specific tri-service life support equipment fitting, supply, and repair procedures. The future of the Army's ALSE direction hinges on these two topics.

CW4 Joseph R. Licina is a member of this council.

Army Aeromedical Concepts Review Committee (AACRC) and AMEDD Aviation Standardization and Safety Committees (AASSC)

The Army Aeromedical Concepts Review Committee (AACRC) and AMEDD Aviation Standardization and Safety Committee (AASSC) are standing committees of the AMEDD for the purpose of collecting and disseminating information relative to aeromedical evacuation concepts, equipment, and techniques, and preparing coordinated AMEDD positions on Army aeromedical evacuation issues. The committee meets formally once a year with representation from the worldwide AMEDD aviation community, Army Reserve, National Guard Bureaus, DA Deputy Chief of Staff for Operation (DCSOPS), and other agencies as appropriate. USAARL, with a mission that includes aeromedical evacuation equipment development as well as general aviation medicine support that encompasses AMEDD aviation, has a long-standing history of intimate participation in the committees' activities.

Tri-Service Life Support Equipment Retrieval Program

USAARL conducts a Tri-Service Aviation Life Support Equipment Retrieval Program (ALSERP) which brings crash-damaged helmets, seats, and flight clothing to our facility for analysis and study. Helmets are the items most often received from the Air Force and Navy.

Army aviation life support equipment involved in either injury causation or prevention in the field is sent to USAARL for biomedical and injury correlation evaluation. The evaluation assesses the effectiveness or deficiencies of the life support equipment through an analysis of the physical condition of the protective devices, the human injury incurred, and the related human dynamics involved in the accident.

Data collected through the ALSERP helps identify hazard protection problems associated with the equipment. Also, these data enable USAARL to provide injury-reducing design recommendations and health criteria for the improvement of life support equipment. The Navy Medical Department maintains a permanent position for a Navy aerospace physiologist at USAARL to support this program but it has remained unfilled for the past 4 years.

Advisory Group for Aerospace Research and Development

This panel was established in May 1952 and was an early pioneer in AGARD to discharge the mission of bringing together leading personalities of the NATO nations in the fields of science and technology relating to aerospace.

The Aerospace Medical Panel (AMP) is concerned with the exchange of information on aerospace medical research and development, the recognition of operationally oriented requirements of clinical aerospace medicine, the solution of human engineering problems, and the stimulation of new research activities to assist and enhance pilot performance in the demanding aviation environment. The panel formally has chartered subcommittees concerned with the specific problems of behavioral sciences, biodynamics, special clinical and physiological problems in military aviation, and special senses.

USAARL has been an active participant with this panel since 1963. Members of the Laboratory serve on AMP subcommittees as technical consultants. COL Dudley R. Price is under appointment by the National Board of Delegates to AGARD/NATO as the U.S. Army representative on this panel.

Committees

Committee	Affiliation	Individual
<u>Aerospace Medical Association</u>		
Scientific Program Committee	Member	COL D.R. Price
	Member	MAJ D.J. Wehrly
Aviation Safety Committee		
Human Factors Subcommittee	Member	Dr. K.A. Kimball
Science & Technology Committee	Member	Dr. K.A. Kimball
<u>American Burn Association</u>		
Prevention Committee	Member	Dr. F.S. Knox, III
<u>Federal Laboratory Consortium</u>		
	Member	Ms. S.H. Bullock
<u>Air Standardization Coordinating Committee (International)</u>		
Working Party 61	Army	Dr. F.S. Knox, III
(Aerospace Medicine & Life Support Systems)	Representatives	Dr. J.K. Crosley
		LTC A.W. Schopper
<u>American National Standards Institute</u>		
S1 Acoustics	USAARL Rep	Dr. J. Patterson, Jr.
	Alternate	Mr. B.T. Mozo
S3 Bioacoustics	USAARL Rep	Dr. J. Patterson, Jr.
	Alternate	Mr. B.T. Mozo
S12 Noise	USAARL Rep	Mr. B.T. Mozo
	Alternate	Dr. J. Patterson, Jr.
Z90-1 Helmet Committee	Member	Mr. J.L. Haley, Jr.
53-62 Working Group on the Effects of Impulse Noise on Man	Member	Dr. J. Patterson, Jr.

Committee	Affiliation	Individual
Working Group on Real-Ear Attenuation Standards	Member	Dr. J. Patterson, Jr.
<u>American National Standards Institute</u>		
F7.08 American Society for Testing and Materials	Member	Dr. J.K. Crosley
<u>Department of Defense</u>		
Aircrew Station Standardization Panel (Tri-Service)	Member	LTC A.W. Schopper
Joint Service Display Panel Subpanel on Display Devices	Member	Mr. C.E. Rash
Human Factors Engineering Technical Advisory Group (Tri-Service)	Member Member	COL J.D. LaMothe Dr. M. Sanders
Joint Working Group to Determine Drug Produced Degradation in Military Performance (Tri-Service)	Member	Dr. K.A. Kimball
Tri-Service Aeromedical Research Panel (TARP)	Member Member	COL D.R. Price COL J.D. LaMothe
Tri-Service Helmet Standardization Working Group	Member	MAJ A.C. Sippo
Tri-Service Aerospace Medical Coordination Technical Working Group	Member	Mr. J.L. Haley, Jr.
<u>Department of the Army</u>		
Senior Advisory Group - LHX Advanced Rotorcraft Technology Integration	Member Member	Dr. M. Sanders COL J.D. LaMothe
Advanced Attack Helicopter Alternate System Safety Group	Member	Mr. R.R. Simmons

Committee	Affiliation	Individual
Advanced Attack Helicopter		
Source Selection	Member	Mr. C.E. Rash
Evaluation Board	Member	Mr. B.T. Mozo
Army Aeromedical Consultant		
Advisory Panel (ACAP)	Member	MAJ A.C. Sippo
Army Aerospace Medicine		
Residency Board	Member	MAJ A.C. Sippo
Army Aviation Personnel		
Requirements for		
Sustained Operations,		
Study Advisory Group	Member	Dr. K.A. Kimball
USAMRDC Vision and Laser	Member	COL J.D. LaMothe
Bioeffects Advisory	Member	Dr. I. Behar
Committee	Member	Dr. R.W. Wiley
MANPRINT Coordination		
Team--Blackhawk Helicopter	Member	LTC B.C. Leibrecht
LHX Wide Field-of-View		
Display Technical		
Advisory Group	Member	Mr. C.E. Rash
USAMRDC Neuroscience		
Working Group for	Member	Dr. A.W. Kirby
Chemical Defense	Member	Dr. T.H. Harding
TSG Ad Hoc Committee	Member	MAJ W.R. Nelson
on Hearing Protective	Member	Dr. J. Patterson, Jr.
Devices	Member	Mr. B.T. Mozo
Army Medical Department		
Aviation Standardization	Voting	
and Safety Committee	Member	LTC E.J. Enloe
Society of U.S. Army		
Flight Surgeons	President	COL D.R. Price

National Academy of Sciences--National Research Council

Committee on Vision	Army Rep	LTC B.C. Leibrecht
	Member	Dr. J.K. Crosley

Committee	Affiliation	Individual
Committee on Hearing, Bioacoustics, and Biomechanics (CHABA)	Army Rep Member Member	LTC B.C. Leibrecht Dr. J. Patterson, Jr. Mr. B.T. Mozo

North Atlantic Treaty Organization--Advisory Group
for Aerospace Research and Development

Aerospace Medical Panel	Army Rep	COL D.R. Price
Behavioral Sciences Committee, AMP	Member	Dr. K.A. Kimball
Evaluation of Methods to Assess Workload, AMP Working Group 08	Member	Dr. K.A. Kimball
Program Committee, Vibration Limits for Effective System Control	Member	Dr. K.A. Kimball
Research Study Group 6, Effects of Impulse Noise	Member	Dr. J. Patterson, Jr.

U.S. Army Aviation Center

NBC Steering Committee	Member	Dr. F.S. Knox, III
Army Aviation Threat Committee	Member	Dr. K.A. Kimball
Army Aviation Mission Area Analysis	Member	Dr. K.A. Kimball
Fort Rucker Flight Standardization Committee	Member	MAJ T.A. Muldoon

<u>National Board of Examiners in Optometry</u> Theoretical, Ophthalmic, and Physiological Optics Committee	Chairman	Dr. R.W. Wiley
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